VOLVO 340, 360 and 480

IGNITION SYSTEM:

BENDIX F 3 A in VOLVO 340, 360 and 480

1. Design and function

The BENDIX F 3 A electronic ignition system fitted in the above-mentioned Volvo models basically corresponds in terms of design and function to the RENTIX ignition system used by Volvo. The control unit processes two main items of information: the signals on engine speed and piston position as well as the pressures in the intake manifold. These pulses are compared to a permanently stored map, in order to determine the ignition point. The knock sensor and engine temperature act as corrected variables. The latter is passed to the ignition unit by the control unit of the LH-Jetronic.

Design:

a) Ignition coil, ignition control unit with output stage and aneroid box for detection of the intake-manifold pressure are integrated into the ignition unit.

b) The ignition distributor is fitted at the cylinder head and is driven directly by the camshaft.

c) The flywheel sensor is attached to the clutch housing. As a result of the teeth of varying width at the ring gear, the sensor can detect the engine speed and piston position and pass them on to the control unit of the ignition unit in the form of voltage signals.

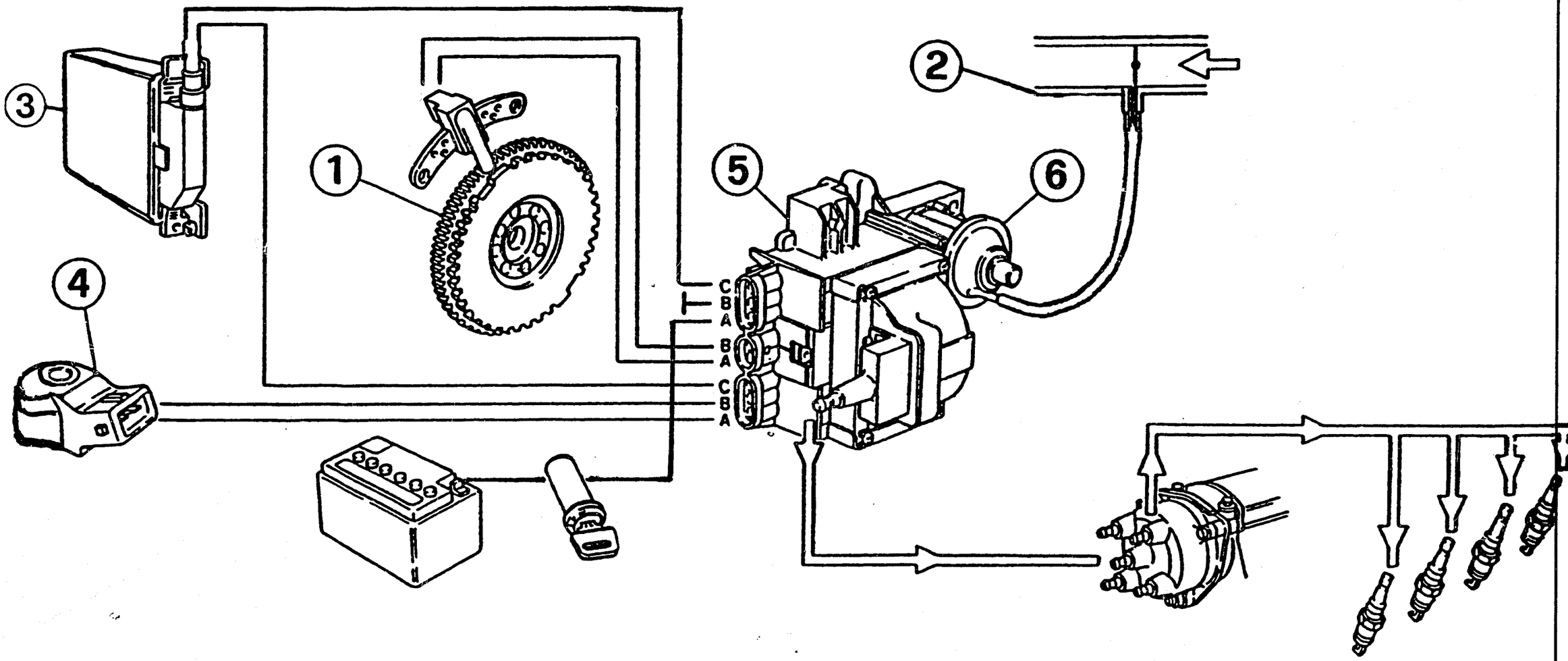


Diagram of ignition system: 1 = Flywheel with sensor
2 = Intake manifold
3 = Control unit
4 = Knock sensor
5 = Ignition unit
6 = Vacuum unit

d) The intake-manifold pressure is tapped downstream of the throttle valve and routed to the aneroid box at the ignition unit. This converts the movement of the diaphragm into an electrical signal which is utilized by the control unit.

e) The knock sensor retards the ignition point as soon as the engine starts to knock.

f) The engine-temperature signal is supplied by the control unit of the fuel-injection system or by the temperature sensor installed beneath the idle positioning motor. The ignition is retarded by 7° at coolant temperatures below 53°C, so as to bring the catalytic converter up to operating temperature more quickly.

2. Testers

The ignition system can be checked/measured with a timing light, a tachometer, a voltmeter and ohmmeter and with a test lamp.

3. Rapid testing of ignition system

A spark test and a check on the ignition point provide rapid information as to the basic functions.

a) To check the ignition spark, one spark-plug cable is to be detached and connected to an ignition-spark tester (spark gap).
   - If there is no spark formation when the starting motor is actuated, the test is to be repeated at the main ignition cable (ignition distributor terminal 4).
   - If the spark formation is O.K., the ignition point is to be checked (3b).
   - If there is no spark formation, the ignition system is to be subjected to a complete check (Section 4).

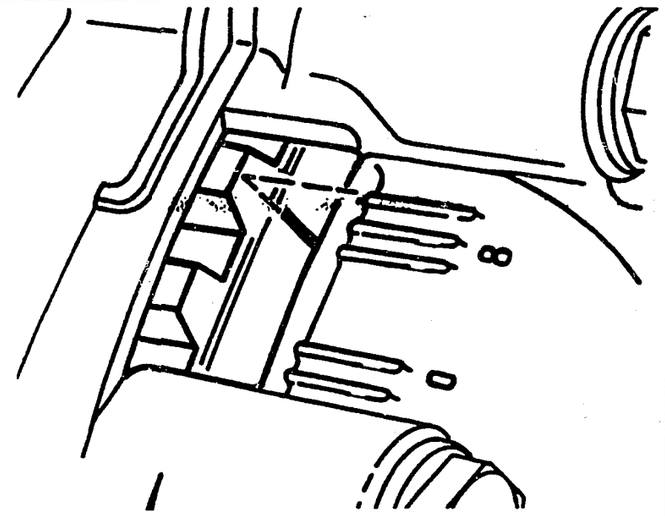
b) The ignition point is checked with vacuum hose connected. The mark is located on the ring gear (top picture) and the graduated scale on the clutch housing. The ignition point cannot be adjusted.
   Set values: - 8° ± 3° BTDC at 800/min $^{-1}$.
   - 31° ± 3° BTDC at 2500/min $^{-1}$.
   - If the figure is outside the tolerance, the ignition unit is to be replaced.

c) The spark plugs must have an electrode gap of 0.7 mm and are to be tightened to 25...30 Nm.

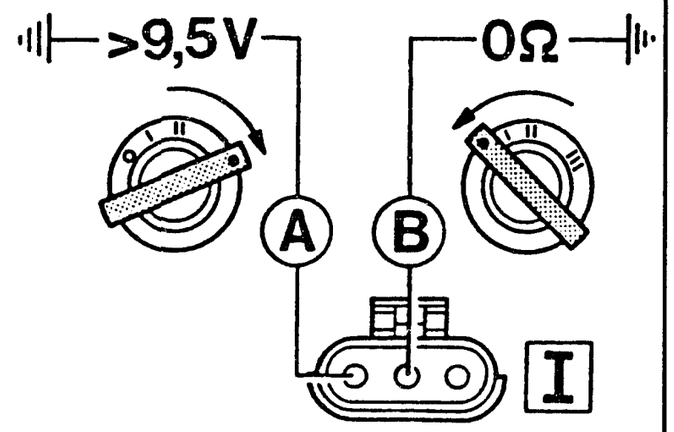
4. Testing of individual components

a) The ignition unit is supplied with power via connection A at plug 1. As a check, this is to be detached from the ignition unit and connected via a voltmeter to ground. The starting motor is to be actuated with the main ignition cable detached (bottom picture).
   - The voltage signal must be at least 9.5 V. If there is no voltage, then there is an open-circuit in the cable between ignition lock and plug. If the voltage is too low, the battery is to be tested.

To check the ground connection, an ohmmeter is to be connected to connection B of plug 1.
- The resistance must be 0 ohms.



Timing marks on ring gear and clutch housing



Checking power supply and ground of ignition unit

b) The function of the flywheel sensor can be checked by connecting a voltmeter (top picture) to the detached plug of the ignition unit. The starting motor is to be actuated with the main ignition cable detached.

- The voltage signal must be between 300 and 400 mV; the needle must vibrate.

- The resistance of the sensor at the plug must be 200 ± 60 Ω (bottom picture).

If these values are not attained, the flywheel and sensor are to be checked for dirt and the sensor is to be replaced if necessary.

c) The vacuum advance can be checked by connecting a vacuum pump to the detached hose at the throttle valve. Generating a vacuum must alter the flywheel mark. There are no precise adjustments.
If there is no change, the vacuum hose, connection points and vacuum unit are to be checked for leaks.

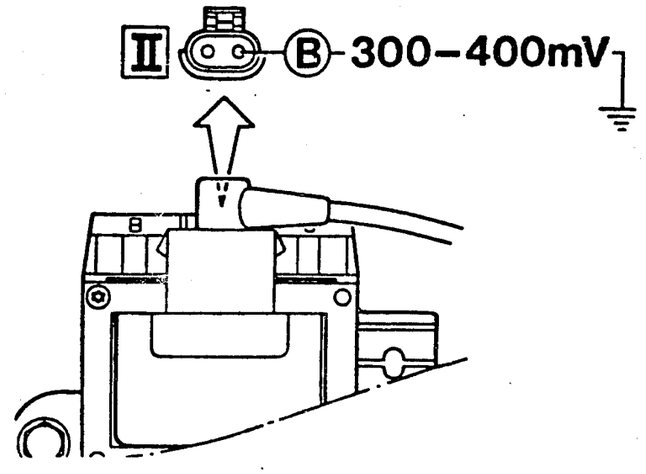
d) The knock sensor is checked by tapping on the engine block with a small hammer in the vicinity of the sensor with the engine running.

- It must be possible to observe ignition retard with a timing lamp.

If this is not the case, the connectors are to be checked for proper contact and the connecting cables for open-circuits. If necessary, the knock sensor is to be replaced.

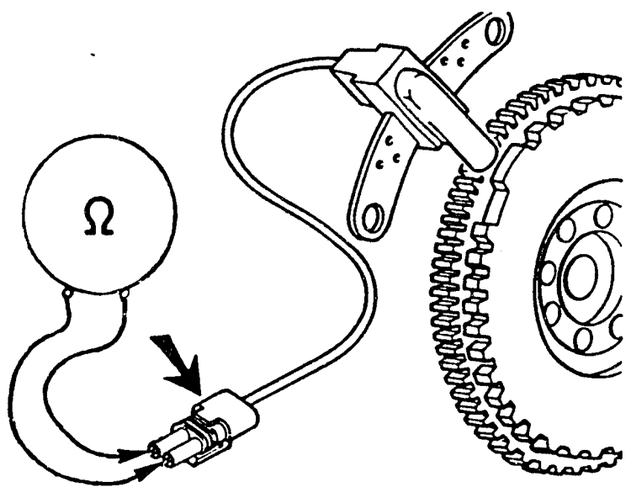
e) The coolant temperature sensor beneath the idle positioning motor of the LH-Jetronic can be tested as to its resistance.

Set values: - At 20° C 2500 ± 220 Ω
- At 80° C 320 ± 40 Ω



Checking voltage signal of flywheel sensor

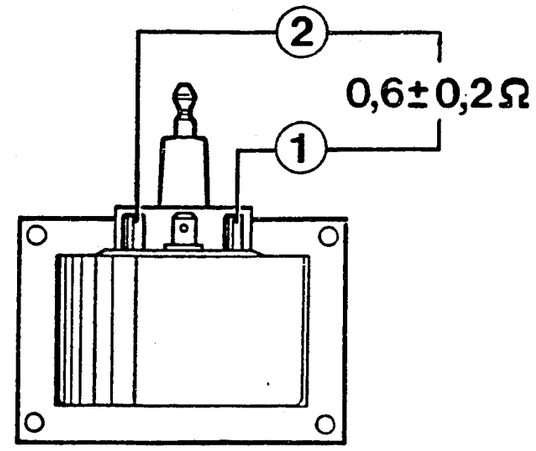
Resistance check at primary winding of ignition coil



f) The ignition coil is to be checked as to its resistances in the normal manner (top and bottom pictures)

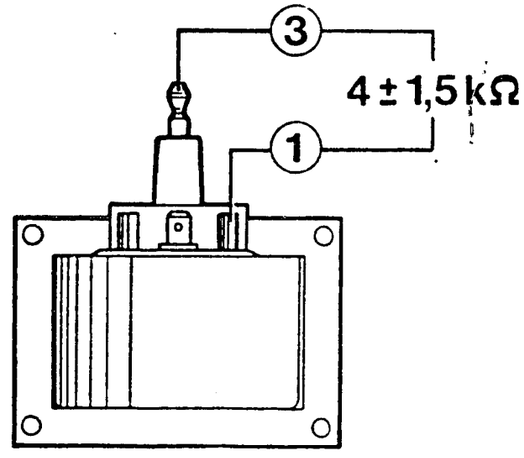
- Resistance of secondary winding = 4000 ± 1500 Ω

- Resistance of primary winding = 0.6 ± 0.2 Ω



Resistance measurement at primary winding of ign. coil

Resistance measurement at secondary winding of ign. coil



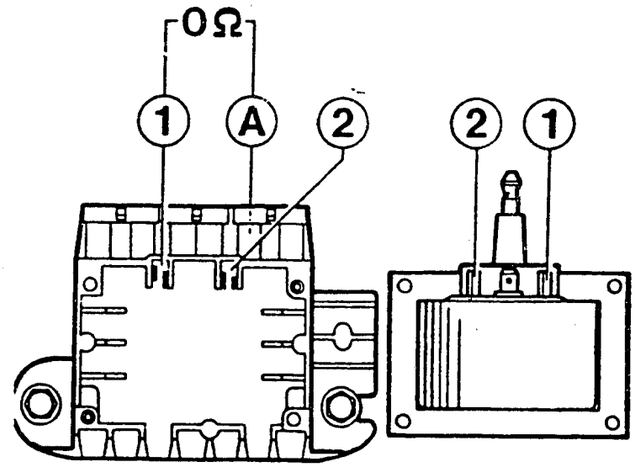
g) The ignition unit can be checked with the ignition coil removed (Section 5).

- Output of ignition unit to ignition coil.
  The resistance between connection A, plug 1 and ignition-coil input must be 0 Ω (top picture).

- Power supply of ignition coil:
  An indicator lamp (12 V, 4 W) is to be connected to the two connections of the ignition coil as shown in the bottom picture.

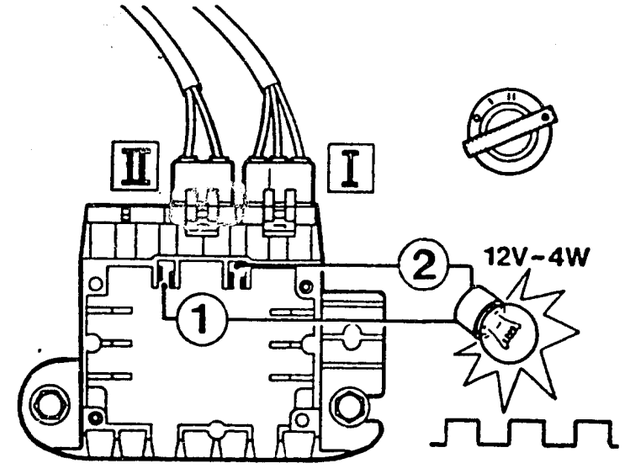
  The lamp must flash when the starting motor is actuated.

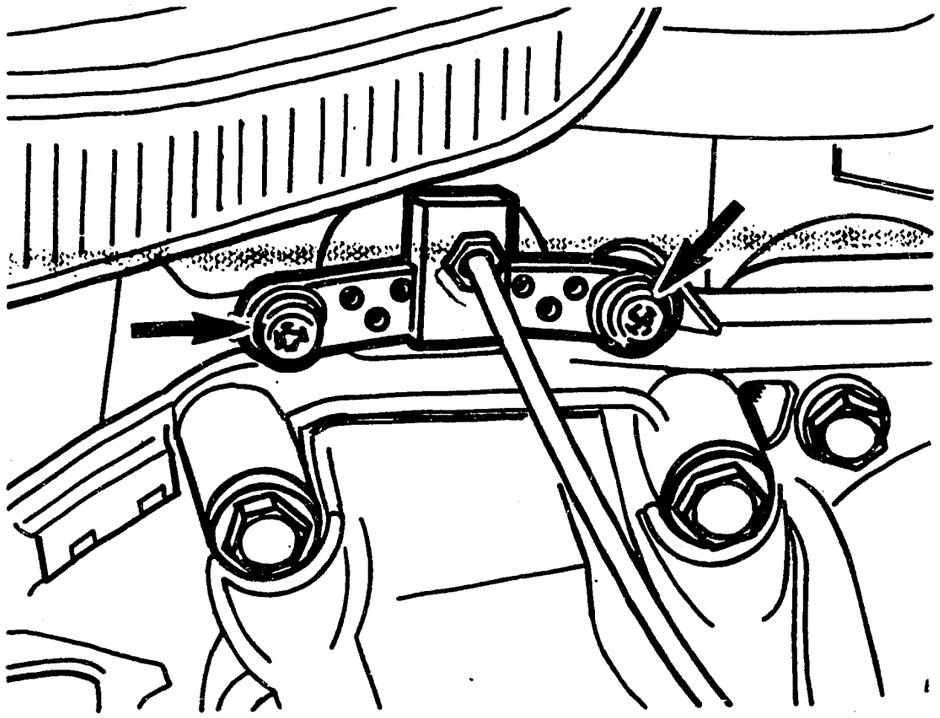
  When the two checks are performed, the ignition unit is to be replaced if the result is negative.



Checking output of ignition coil

Checking power supply to ignition coil





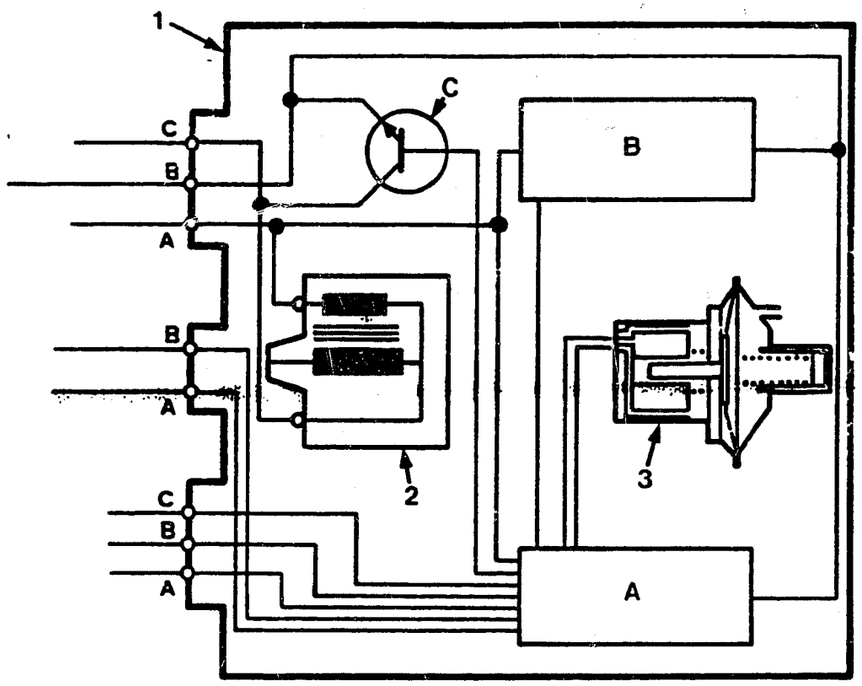
Arrow = Fastening screws

Installation position of flywheel sensor

5. Replacement of individual assemblies

The ignition coil can be removed separately from the ignition unit by detaching the main ignition cable and removing the two fastening screws.

The flywheel sensor is attached to the clutch housing by means of two screws.
It is not possible to adjust either the distance from the flywheel or the position in the direction of motion (picture).



1 = Ignition unit with computer (A), stored map (B) and output stage (C)

2 = Ignition coil

3 = Vacuum unit

Circuit diagram of ignition unit with connectors.

6. Technical data

Ignition system	Make and type	Bendix F 3 A
Firing sequence		1 – 3 – 4 – 2
Cylinder no. 1		At flywheel
Spark plugs	Electrode gap	0.7 mm
Ignition coil	Primary resistance Secondary resistance	0.6 ± 0.2 Ω 4000 ± 1500 Ω
Flywheel sensor	Resistance Air gap	220 ± 60 Ω Cannot be adjusted
Temperature sensor	Resistance at 20° C at 80° C	 2500 ± 220 Ω 320 ± 40 Ω

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto-Technik" magazine published by the AT-Fachschriftenverlag AG, CH-5001 Aarau.

The BOSCH equipment and the test specifications/ settings for BOSCH products and components are always to be taken from the BOSCH microcards. Test specifications and circuit diagrams are contained in the microcards and workshop documentation already introduced into BOSCH after-sales-service workshops.

AUDI 80/90/100 2.31 Cat

IGNITION SYSTEM

AUDI 80 Quattro (USA) 2.31 CAT Engine type NG
AUDI 90 2.3 1 CAT (1987 ->) Engine type NF
AUDI Coupé 2.3 1 CAT (11.88->) Engine type NG

1. Construction and Operation

The Audi 100 with 5-cylinder engine (2.3 1), Type NG, is equipped with a fully electronic ignition system (FEI). An electronic control unit determines the respective ignition point as a function of a pre-programmed characteristic map on the basis of the incoming information from the Hall generator, knock sensor, temperature sensor, throttle-valve switch, air-flow sensor and altitude sensor.

The control unit of the ignition system is installed in the footwell at the front right beneath the cover of the A-pillar. It directly drives the output stage mounted near the ignition coil. Faults that arise are stored in the control unit of the ignition system and fuel-injection system. Self-diagnosis must be called up before carrying out repairs and for the purpose of trouble-shooting (Coordinate 07).

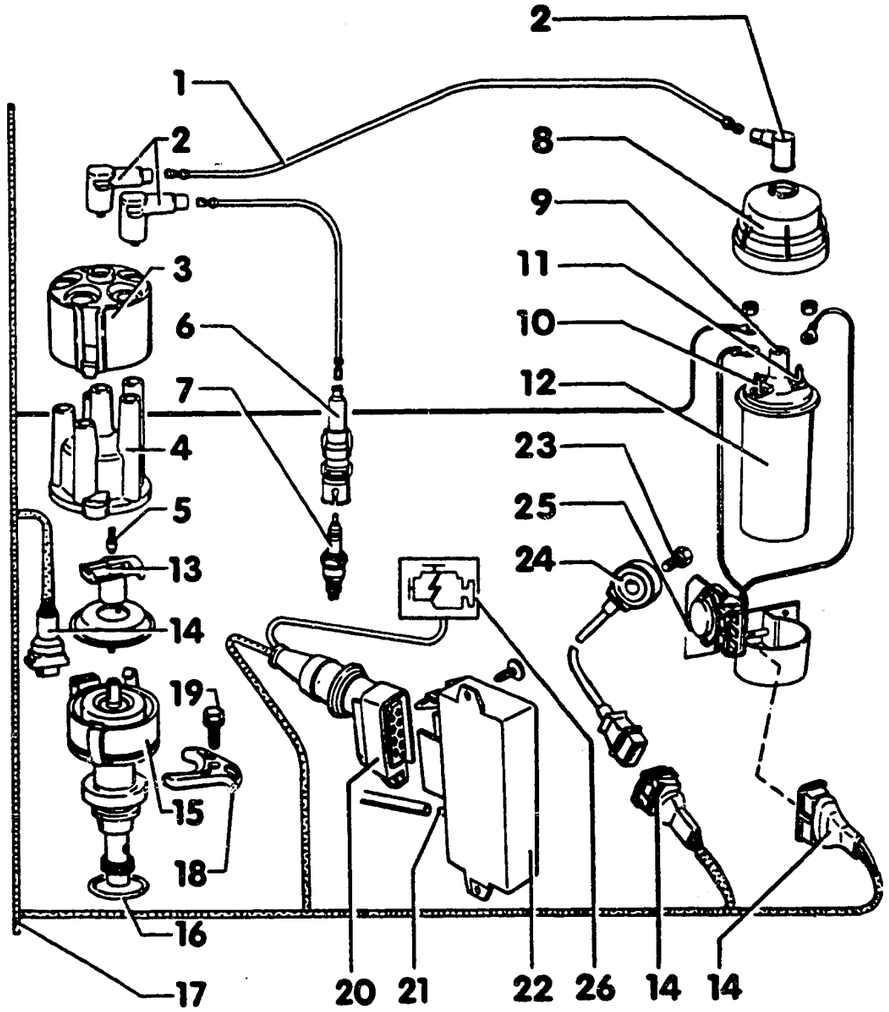
The Hall generator is installed in the ignition distributor. It is supplied with power by the control unit.

The knock sensor is mounted on the engine block.

The throttle-valve switch specifies the positions for idle and full load to the control unit.

The altitude sensor is in the front right footwell above the FEI control unit.

For production reasons: continued on the following coordinate.



WS000012

COMPONENTS OF THE IGNITION SYSTEM

1 = Ignition cable
2 = Suppressor
3 = Shield
4 = Distributor cap
5 = Carbon brush
6 = Spark-plug connector
7 = Spark plug
8 = Protective cap
9 = Terminal 4
10 = Terminal 1 (-)
11 = Terminal 15 (+)
12 = Ignition coil
13 = Distributor rotor
14 = Plug
15 = Ignition distributor
16 = O-ring
17 = Wiring harness
18 = Clamping piece
19 = Screw
20 = Four-pin plug
21 = Vacuum connection
22 = FEI control unit
23 = Screw of knock sensor
24 = Knock sensor
25 = Power stage
26 = Lamp of self-diagnosis

SAFETY INSTRUCTIONS

When working on vehicles equipped with a fully electronic ignition system, make sure that you observe the following instructions:

- Do not touch or disconnect ignition cable while the engine is running or the starting motor is turning.

- Do not connect or disconnect any cables of the ignition system while the ignitiion is switched on.

- If the engine is supposed to be turned only at starting-motor speed, disconnect the main ignition cable from the ignition distributor and apply it to ground.

- Starting aid using a boost battery charger is permissible only for 1 minute at a maxium of 16.5 V.

- Switch off the ignition when cleaning the engine.

- Disconnect the battery before carrying out any electrical welding work.

- When towing away vehicles with a defect in the ignition system, disconnect the plug from the output stage.

- If the vehicle is heated up in a drying oven (for paint work), start the engine only after it has cooled down!

When performing interference-suppression measures on the engine, observe the following instructions:

- Do not connect a capacitor to terminal 1 of the ignition coil.

- The distributor rotor with the identification code R1 (1 k Ω) must not be exchanged.

- The ignition cables may have a maximum resistance of 1 k Ω and the spark plugs a maximum of 5 k Ω .

2. Test equipment

The ignition system can be tested with the aid of a timing strobe, a voltmeter, an ohmmeter and a voltage tester.

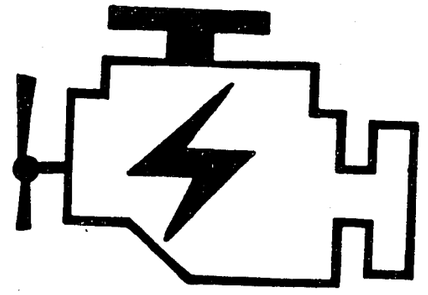
3. Self-diagnosis

Operation: Both the ignition-system control unit and the control unit of the injection system have a fault memory at their disposal for the purpose of self-diagnosis. When the self-diagnosis function is called up, the control unit indicates the faults stored, one after the other, by means of the fault lamp (in the instrument panel) flashing. The contents of the memory are kept only while the ignition is switched on and are cancelled as soon as it is switched off. In the case of a serious fault, the check lamp flashes even while the engine is running (upper and lower illustrations).

The following table explains which types of fault can be stored in which control unit:

Operation	Flashing code	Fault mem. in FEI	KE III
1. Control unit	1 1 1 1	x	x
2. Idle switch – (throttle-valve switch I)	2 1 2 1	x	x
3. Engine speed from FEI control unit	2 1 2 2		x
4. Full-load switch – (throttle-valve switch II)	2 1 2 3	x	x
5. Knock control – control limit stop reached	2 1 4 1	x	
6. Knock sensor (knock detection)	2 1 4 2	x	
7. Altitude sensor	2 2 2 3	x	x
8. Potentiometer on air-flow sensor and/or load signal from KE III control unit	2 2 3 2	x	
9. Reference voltage for load signal and altitude signal from KE III control unit	2 2 3 3	x	
10. Sensor for coolant temperature	2 3 1 2	x	x
11. Control valve for idle stabilization	4 4 3 1		x
12. No fault detected	4 4 4 4	x	x
13. End of fault output	0 0 0 0*	x	x

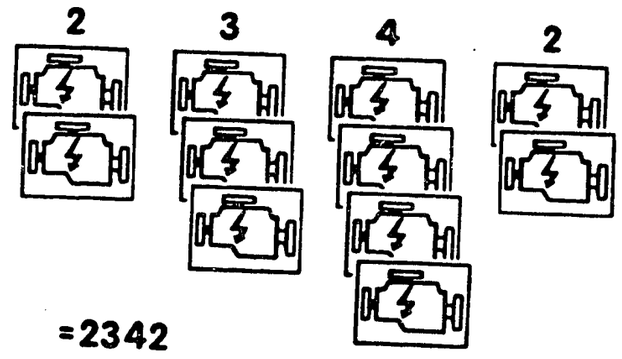
* Fault lamp flashes at intervals of 2.5 s



WS000013

The fault lamp of the self-diagnosis is accomodated in the instrument panel.

A fault code consists of four flashing pulse groups, each of which contains a maximum of four flashes from the lamp.



WS000014

Reading off:

To check, the indicator must light up when the ignition is swichted on If this is not the case, jumper the fuel-pump relay using the auxiliary fuse (upper illustration).
Initiation of fault indication (next section) is followed by a starting signal and then a pause of 2.5 s. The subsequent flashing code is comprised of four flashing pulse groups, each of which consists of a maximum of four flashing pulses. One pulse and the interval period between the pulses amount in each case to 0.5 s. A pause of 2.5 s is left in each case between the individual flash groups and at the end of the flashing code.
Consecutive flashes of 2.5 s with pauses of the same length indicate the end of the fault output.

Calling up:

Before the memory is called up, the following points must be OK:

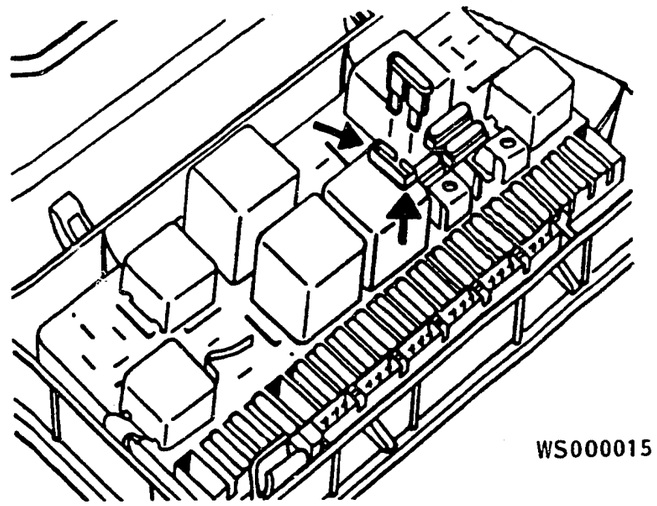
- fuses 13, 24 and 28

- air conditioner switched off

- chassis connection at the intake manifold

- the fault lamp must light up when the ignition is switched on.

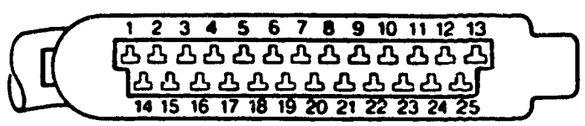
If the fault indicator does not light up when the ignition is switched on, but only after the contacts on the fuel-pump relay have been jumpered, check the lead between the FEI control unit (terminal 3) and the KE-Jetronic control unit (terminal 13) for open circuit. If no fault is detected, connect a voltage tester between terminals 13 and 14 of the disconnected plug of the KE-Jetronic control unit. The light-emitting diode of the voltage tester must flash approx. three times each time the ignition is switched on. If it does not, replace the FEI control unit.



WS000015

Fuel-pump relay with auxiliary fuse

Plug of the FEI control unit

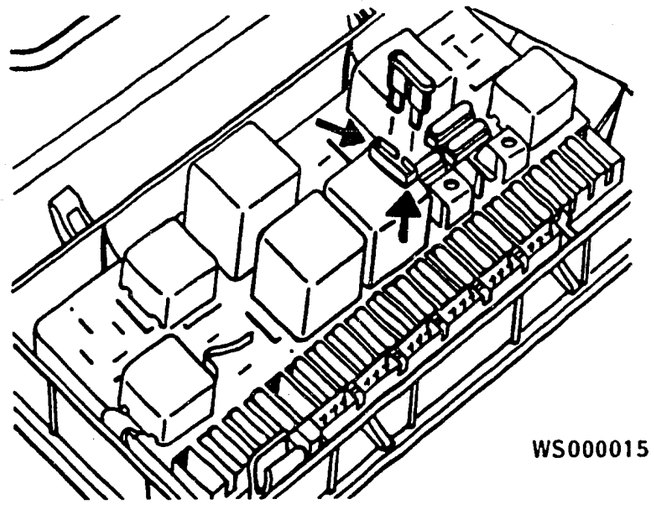


WS000016

After these checks, start the engine and drive the car for approx. 5 min., increasing the engine speed at some stage to above 3000/min $^{-1}$. and briefly depressing the accelerator pedal fully. After this drive, the engine must be left AT IDLE for calling up the flashing code. The engine must not be accelerated, since otherwise the faults stored are cleared.

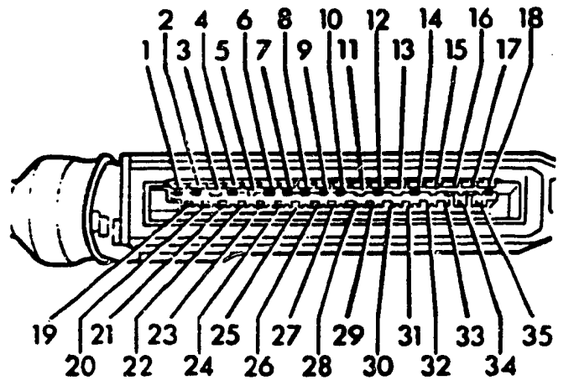
If the lamp does not go out, the contents of the memory must be called up by jumpering the test contacts at the fuel-pump relay for a minimum of 4 s (with the aid of a fuse) (upper illustration). All other faults must be called up in the same manner until the flashing code indicates the end of fault output.

The faults stored in the control unit of the KE-Jetronic can ben called up in the same way afterwards.



Fuel-pump relay with auxiliary fuse

Number codes on the disconnected plugs of the KE-Jetronic control unit



4. Test program of the self-diagnosis

Flash. code	Source of fault	Possible cause of fault	Fault elimination
1 1 1 1	Control unit	Components in control unit	- Replace control unit
2 1 2 1	Idle switch - throttle-valve switch I -	Idle switch defective	- Test idle switch
		Line has short circuit to positive	- Check leads
2 1 2 2	No engine-speed signal from FEI control unit	Open circuit between contact 17 of FEI control unit and contact 30 of KE control unit.	- Check leads
		FEI control unit defective	- Replace FEI control unit
		Hall generator defective	- Test Hall generator
2 1 2 3	Full-load switch - throttle-valve switch II -	Full-load switch sticking (permanently closed)	- Test full-load switch
		Lead has short circuit to positive	- Check leads
2 1 4 1	Knock control at control limit	Engine pinging, knocking	Test compression, fuel-injection system
		Octane rating of fuel too low.	Fill up with specified fuel
		Ignition point set incorrectly	Set ignition point
		Shield of knock-sensor lead damaged	Check leads of knock sensor
2 1 4 2	Knock sensor/knock detection	Open circuit or short circuit in the sensor lead	Check lead between knock sensor and FEI control unit
		Knock sensor defective	Replace knock sensor
		No knock detection by FEI control unit	Replace FEI control unit

Test program of the self-diagnosis (Continued)

Flash. code	Source of fault	Possible cause of trouble	Fault elimination
2 2 2 3	Altitude sensor	Open circuit or short circuit between the control units and altitude sensor	– Check leads
		Altitude sensor defective	Test altitude sensor
2 2 3 2	Potentiometer at air-flow sensor	Open circuit or short circuit between KE control unit and potentiometer	Test potentiometer – Check leads
	Load signal	Open circuit or short circuit between KE control unit, contact 21 and FEI control unit, contact 8	– Check leads
2 2 3 3	Reference voltage for load signal and altitude signal from KE III control unit	Open circuit between FEI control unit, contact 21 and KE control unit, contact 26	– Check leads
2 3 1 2	Temperatur sensor for coolant	Open circuit or short circuit in sensor lead	– Check leads
		Temperature sensor defective	– Test temperature sensor
4 4 3 1	Control valve for idle stabilization	Open circuit or short circuit between KE control unit and control valve	– Conduct final-controlling-element diagnosis – Check leads
4 4 4 4	No fault detected	—	—

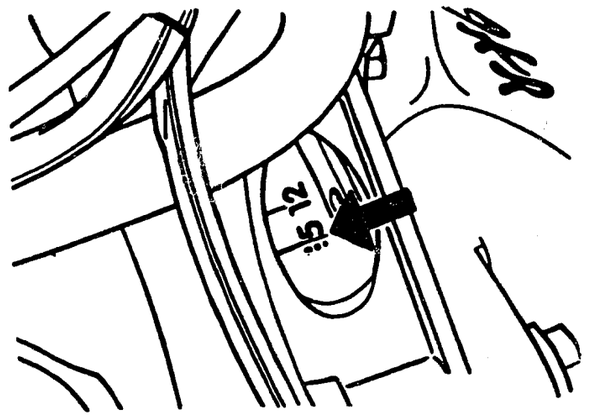
Testing of individual components

a) For checking the ignition point, the engine-oil temperature must be at 80°C, the air conditioner switched off and the knock sensor OK.
After starting the engine, insert the fuse in the fuel-pump relay and test the ignition point 4 s afterwards. The markings are located on the flywheel ring gear and on the clutch housing (upper illustration).

- At idle speed (720...860 min^{-1}), the ignition point must be 13...17° before TDC. Set by turning the ignition distributor to 15° ± 1° before TDC.

- To check the timing advance, remove the fuse from the fuel-pump relay again, increase the engine speed briefly to above 2500 min^{-1} and allow to fall back to idle speed. The ignition point must fluctuate between 7°...20° before TDC on doing this.

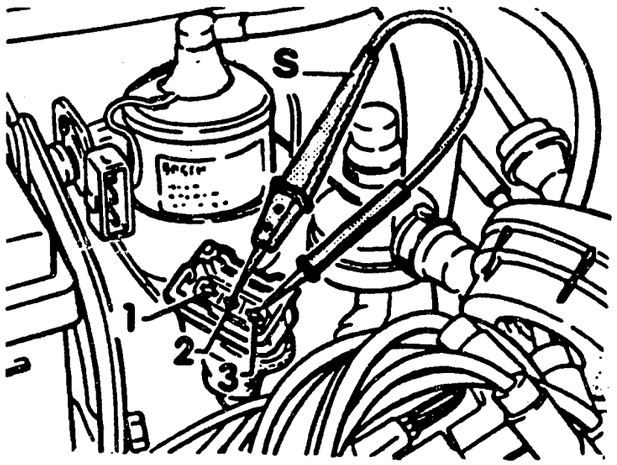
b) The Hall generator must be tested only if there is no ignition spark.
To do this, disconnect the plug from the output stage on the ignition coil and connect a voltage tester in accordance with the lower illustration.



WS000018

Markings for checking the ignition point

Functional check of the Hall generator



WS000019

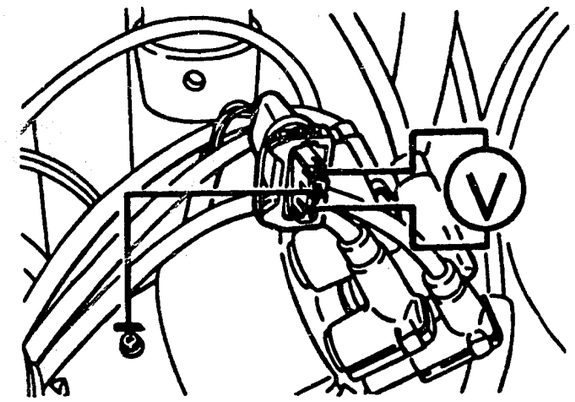
- Flickering of the light-emitting diode (LED) when the starting motor is actuated indicates that the Hall generator is functioning.

  If the LED does not flicker, disconnect the plug from the Hall generator and the ignition distributor and the check the voltage supply from the control unit with the ignition switched on (upper illustration).

- The input voltage at the Hall generator must be at least 9 V.

  The plug must be reconnected afterwards with the rubber sleeve removed. Using a voltage tester, test the signal of the Hall generator once again with the starting motor turning (lower illustration).

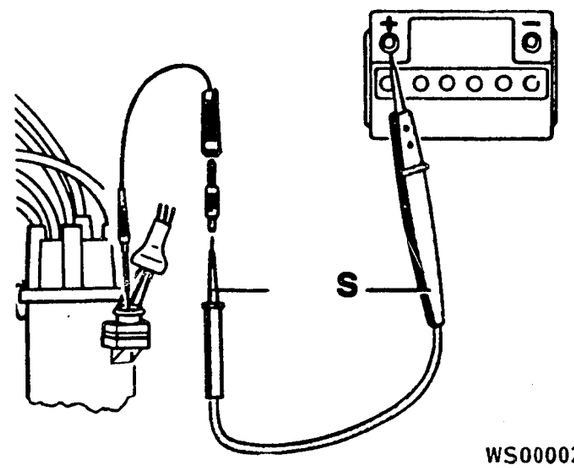
- If the light-emitting diode of the voltage tester does not flicker, the Hall generator and/or control unit is defective.



WS000020

Checking of the input voltage at the plug of the Hall generator.

Functional check of the Hall generator



WS000021

c) Before testing the output stage, check the ignition coil (Chapter 5e).

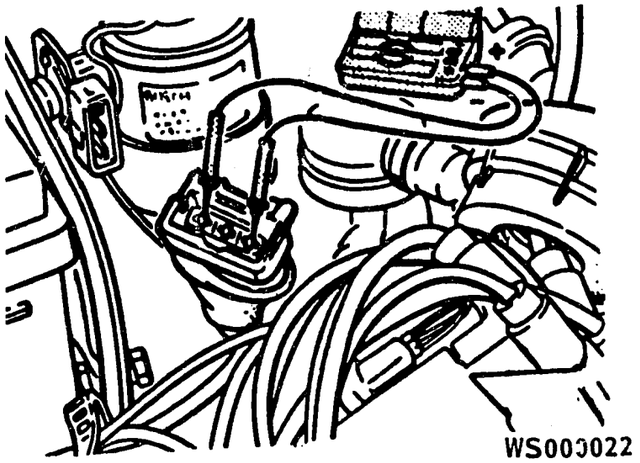
The input voltage of the output stage can be measured using a voltmeter at the disconnected plug (upper illustration).

- Approx. battery voltage must be applied to the output stage. If this is not the case, there is probably an open circuit in a lead.

Using a voltage tester, then test the signal from the Hall generator (in accordance with Chapter 5b). Afterwards, reconnect the plug to the output stage (with the ignition switched off) and disconnect the plug from the Hall generator. Connect a voltmeter to the ignition coil (lower illustration) and switch on the ignition.
Connect the center contact of the disconnected plug of the Hall generator briefly to ground.

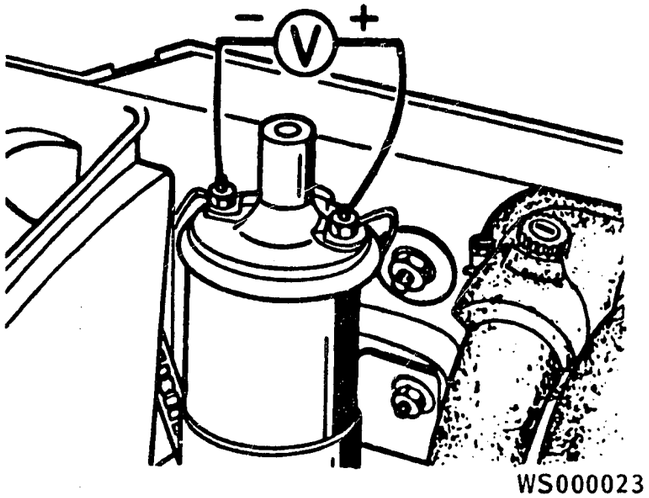
- The voltmeter must indicate at least 2 V and then fall back to 0 V after 1...2 s.

- If the voltage does not fall back, try replacing the output stage and/or control unit and test whether any sealing compound has escaped from the ignition coil.
This must also be replaced if necessary.



Measuring the input voltage at the plug of the output stage

Functional check of the output stage by means of voltage measurement at the ignition coil

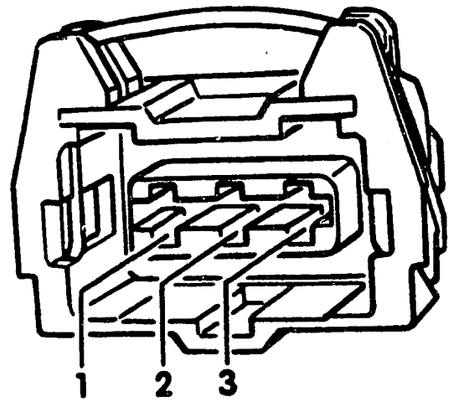


d) The altitude sensor cannot be tested using the usual measuring instruments; however, it is possible to measure the input voltage. To do this, remove the control unit of the ignition system, disconnect its connectors, and disconnect the plug from altitude sensor. Measure the voltage values at the plug of the altitude sensor while the ignition is switched on (lower illustration):

Connection	Set value
1 and 2	4.5...5.0 V
2 and 3	4.5...5.0 V
1 and ground (engine)	approx. 5.0 V

- If these values are not obtained, check the leads between the altitude sensor and KE-Jetronic control unit and replace the control unit if necessary.

- If the values are obtained, try replacing the altitude sensor.



WS000024

Checking the input voltage at the plug of the altitude sensor.

e) Measure the primary and secondary resistances at the ignition coil and check whether any sealing compound has excaped.

6. Work instructions

When tightening the fastening screw of the knock sensor, make sure that you observe the tightening torque 15...25 Nm, since operation of the knock is disrupted if the unit is not mounted properly.

Spark-plug tightening torque = 20 Nm

Electrode gap = 0.7...0.9 mm.

7. Technical Data

Engine	Type	2.3l "NG" 100 kW
Ignition system	Make/Type	FEI
Firing order		1-2-4-5-3
Spark plugs	Make/Type	VW/Audi 191 905 450 A Bosch W7DTC Champion N7BYC
	Electrode gap	0.7...0.9 mm
Ignition coil	Primary resistance	0.5...1.5 Ω
	Secondary resistance	5.0...9.0 k Ω
	Spark-plug resistance	4.0...6.0 k Ω
	Suppressor reistance	0.6...1.4 k Ω
Ignition point	Test value	13...17° bef. TDC
	Setting	15 ± 1° bef. TDC
Idle speed		720...860 min $^{-1}$

This microcard was prepared exclusively for Bosch Service on behalf of ROBERT BOSCH GMBH STUTTGART

For production reasons: continued on the following coordinate.

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto-Technik" magazine published by the AT-Fachschriftenverlag AG, CH-5001 Aarau.

The BOSCH equipment and the test specifications/ settings for BOSCH products and components are always to be taken from the BOSCH microcards. Test specifications and circuit diagrams are contained in the microcards and workshop documentation already introduced into BOSCH after-sales-service workshops.

IGNITION SYSTEM

Audi 80 2.0 l Cat. (1987)

Audi 90 2.0 l Cat. (1987) Type PS

Audi 100 2.0 l Cat.

1. Construction and Operation

The Audi 90 with 5-cylinder engine (2.0 l), Type PS, is equipped with a fully electronic ignition system (FEI). An electronic control unit determines the respective ignition point in accordance with a pre-programmed characteristic map, on the basis of the incoming information from the Hall generator, knock sensor, temperature sensor, throttle-valve switch and intake-manifold vacuum sensor.

The control unit of the ignition system is installed in the footwell at the front right beneath the cover of the A-pillar. It directly drives the output stage mounted near the ignition coil. Any faults that occur are stored in the control unit. The self-diagnosis must be called up before repairs and for the purpose of trouble-shooting (Coordinate 07).

The Hall generator is installed in the ignition distributor. It is supplied with power by the control unit.

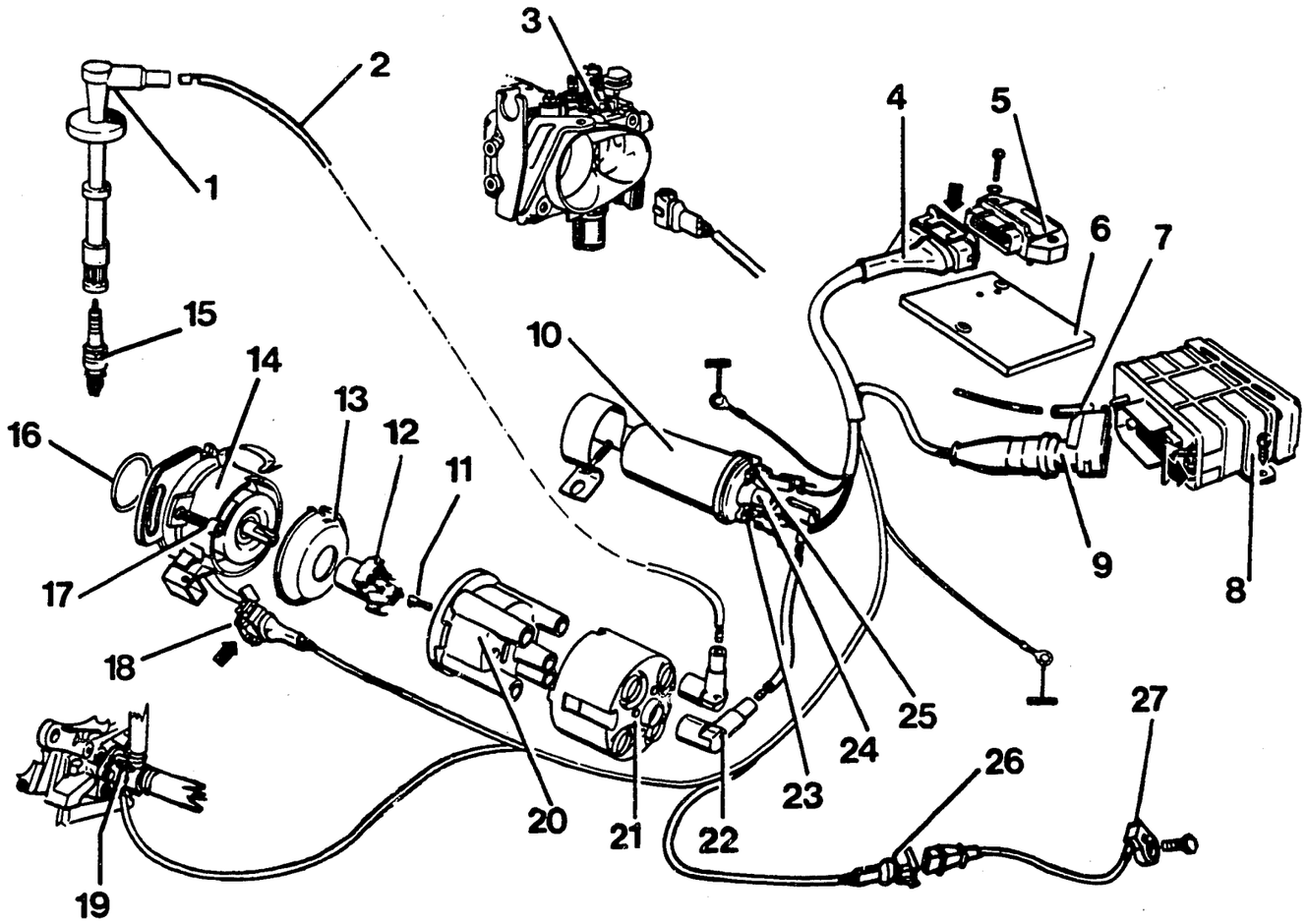
The knock sensor is mounted on the engine block.

The throttle-valve switch specifies the positions for idle and full load to the control unit.

Safety instructions !

When working on vehicles equipped with a fully electronic ignition system, observe the following instructions:

- Do not touch or disconnect ignition cables while the engine is running or the starting motor turning.
- Do not connect or disconnect any cables of the ignition system while the ignition is switched on.
- If the engine is supposed to be turned only at starting-motor speed, disconnect the main ignition cable from the ignition distributor and apply to ground.
- Starting aid using a boost battery charger is permissible only for 1 minute at a maximum of 16.5 V.
- Switch off the ignition when cleaning the engine.
- Disconnect the battery when performing electrical welding work.
- When towing away vehicles with a defect in the ignition system, disconnect the plug from the output stage.
- If the vehicle is heated up in a drying oven (for paint work), start the engine only after it has cooled down.



WS000025

Components of the ignition system

1 = Spark-plug connector	8 = FEI control unit	15 = Spark plug	22 = Suppressor
2 = Ignition cable	9 = Plug	16 = O-ring	23 = Terminal 15
3 = Throttle-valve switch	10 = Ignition coil	17 = Screw	24 = Connection 4
4 = Plug	11 = Carbon brush w/spring	18 = Plug	25 = Terminal 1
5 = TCI-H trigger box	12 = Distributor rotor	19 = Temperature sensor	26 = Plug
6 = Heat sink	13 = Dust-protection cover	20 = Distributor cover	27 = Knock sensor
7 = Vacuum line	14 = Ignition distributor	21 = Interf. suppr. cap	

When carrying out interference-suppression measures on the engine, observe the following instructions:
- do not connect a capacitor to terminal 1 of the ignition coil.
- the distributor rotor with the identification code R1 (1 k Ω) must not be exchanged.
- the ignition cables may have a resistance of a maximum of 1 k Ω and the spark plugs a maximum of 5 k Ω .

2. Test equipment

The ignition system can be tested with the aid of a timing strobe, c voltmeter, an ohm-meter and a voltage tester with light-emitting diode.

For production reasons: continued on the following coordinate.

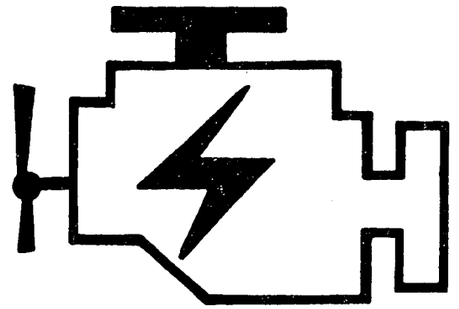
3. Self-diagnosis

Operation:

When calling up self-diagnosis, the control unit indicates the faults stored one after the other by means of the fault lamp (in the instrument panel) flashing.

The contents of the memory are kept only while the ignition is switched on and are cleared as soon as it is switched off.

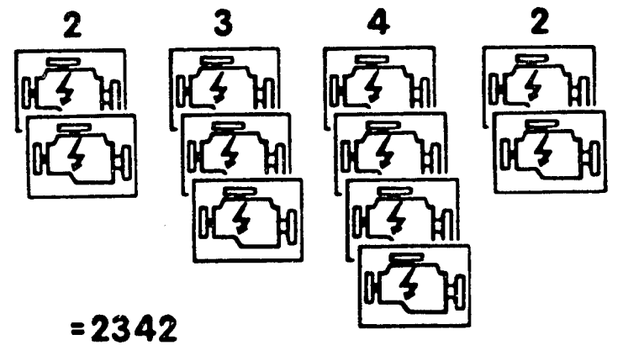
If there is a serious fault, the indicator lamp flashes even while the engine is running (upper and lower illustrations).



WS000013

The fault lamp of the self-diagnosis function is accomodated in the instrument panel.

A fault code consists of four flashing pulse groups, each of which comprises a maximum of four flashing pulses.



WS000014

Reading off:

For checking, the indicator must light up when the ignition is switched on. If this is not the case, jumper the fuel-pump relay using the auxiliary fuse (upper illustration). Initiation of fault indication (next section) is followed by a starting signal and then by a pause of 2.5 s.

The subsequent flashing code is comprised of four flashing pulse groups, each group consisting of a maximum of four flashing pulses. A pulse and the interval period between the pulses amount in each case to 0.5 s. A pause of 2.5 s is left in each case between the individual flash groups and at the end of the flashing code.

Consecutive flashes of 2.5 s with pauses of the same length indicate the end of fault output.

Calling up:

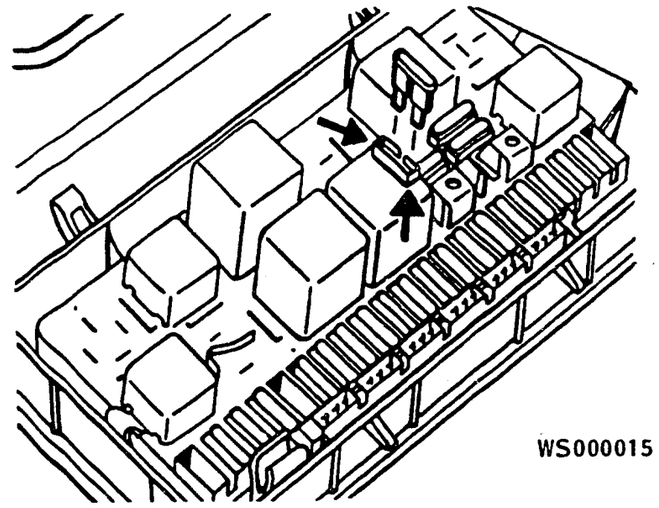
Before the memory is called up, the following points must be OK:

- Fuse 24
- Fuel-pump relay
- Timing of the ignition point advanced (Coordinate 15)
- Throttle-valve switch (switched on at idle)
- Chassis connection at intake manifold
- The fault lamp must light up when the ignition is switched on.

After carrying out these checks, start the engine and briefly fully depress the accelerator pedal once (above 3000/min $^{-1}$).

- If the fault lamp goes out, no faults are stored.
- If the fault lamp does not go out, call up the memory by jumpering the test contacts at the fuel-pump relay for at least 4 s (with the aid of a fuse) (upper illustration).

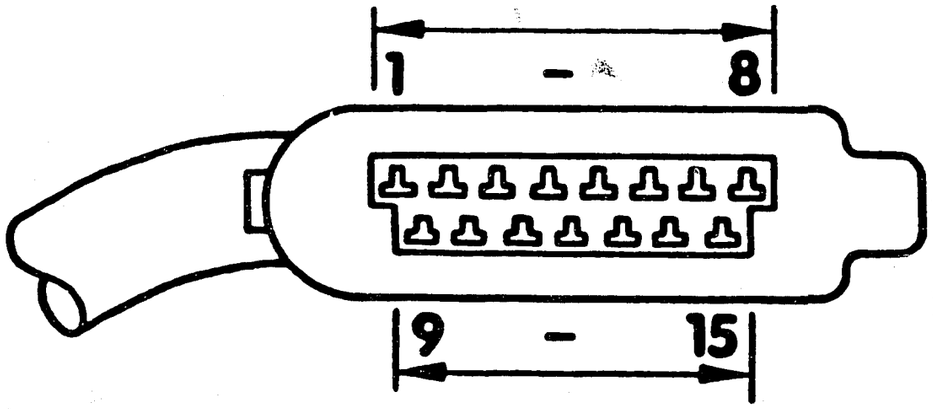
All other faults must be called up in the same manner until the flashing code indicates the end of fault output.



Jumpering of the test contacts on the fuel-pump relay using the auxiliary fuse.

4. Test program of the self-diagnosis

Flashing code	Source of fault	Possible cause of fault	Fault elimination
2 1 4 1	Knock control at the control limit	Engine pinging, knocking	Test compression, fuel-injection system.
		Octane rating of fuel too low	Fill up with specified fuel
		Ignition point set incorrectly	Set ignition point
		Shield of knock-sensor lead damaged	Check leads of knock sensor
2 1 4 2	Knock sensor/knock detection	Open circuit or short circuit in sensor lead	Check lead between knock sensor and FEI control unit
		Knock sensor defective	Replace knock sensor
		No knock detection by FEI control unit	Replace FEI control unit
2 2 2 1	Vacuum hose to control unit	Vacuum hose from throttle-valve assembly to control unit dropped off, pinched, torn	Check vacuum hose
2 2 2 2	Full-load switch - throttle-valve switch II	Full-load switch set incorrectly, defective	Test throttle-valve switch II (full-load switch) and set - Repair Group 25,
	Pressure sensor (in control unit)	Pressure sensor defective	replace KE-Jetronic control unit
2 3 1 2	Temperature sensor for coolant	Open circuit or short circuit in in sensor lead	- Check leads
		Temperature sensor defective	- Test temperature sensor
4 4 4 4	No fault detected	—	—
0 0 0 0 Fault lamp flashes at intervals of 2.5 s	End of fault output		



WS000026

Number code on disconnected plug of the FEI control unit

5. Testing the individual components

a) The cable connections and plug-in connections can be checked with regard to correct connection and continuity at the disconnected plug of the control unit using a voltmeter and ohmmeter and in accordance with the following table.

Voltage measurement:

Battery voltage must prevail between the following connections under the specified test conditions:

3 + 5	o Ignition switched on
3 + 6	o Ignition switched on o Idle switch switched on (throttle valve in idle position)
3 + 8	o Ignition switched on – actuate full-load switch
3 + 10	o Ignition switched on
4 + 5	o Ignition switched on – jumper contacts at fuel-pump relay using fuse.

Resistance measurement:

Continuity must prevail between the following connections under the specified test conditions:

2 + (25)*	– Unclip plug from KE-Jetronic control unit
3 + 12	– Disconnect plug from our output stage and jumper terms. 2 + 3
13 + 14	– Pull apart plug-in connection to knock sensor and jumper the 3 terminals in plug
7 + 15	– Disconnect plug from Hall generator and jumper outer leads
7 + 9	– Jumper center lead and outer lead – brown/white – at disconnected plug of Hall generator
3 + 1	o Plug on temperature sensor plugged in

b) For checking the ignition point, the engine-oil temperature must be at 80°C, the throttle-valve switch in idle position (switched on), and the knock sensor OK. The markings are located on the flywheel ring gear and on the clutch housing (upper illustration)

- At idle speed (750...850/min $^{-1}$), the ignition point must be at 16...20° before TDC. Set by turning the ignition distributor to 18° ± 1°.

- In order to test the timing advance given by the control unit, disconnect the vacuum hose at idle and increase the engine speed by 300/min $^{-1}$. The ignition point must be advanced by 7°. If this is not the case, the control unit is defective.

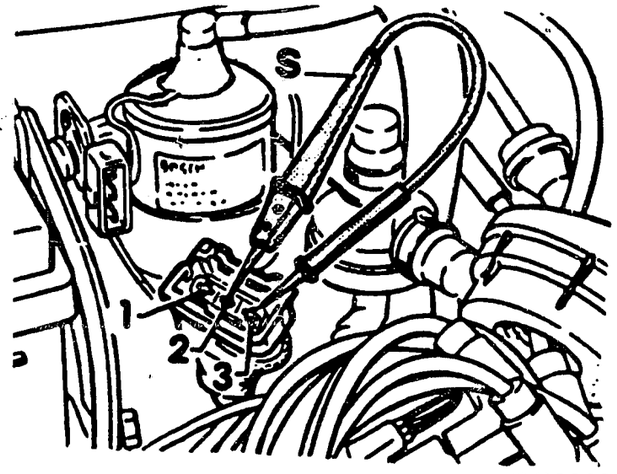
c) The Hall generator must be tested only if there is no ignition spark.

To do this, disconnect the plug from the output stage at the ignition coil and connect a voltage tester in accordance with the lower illustration.

WS000027

Markings for checking the ignition point

Functional check of the Hall generator using the voltage tester S at the plug to the output stage



WS000019

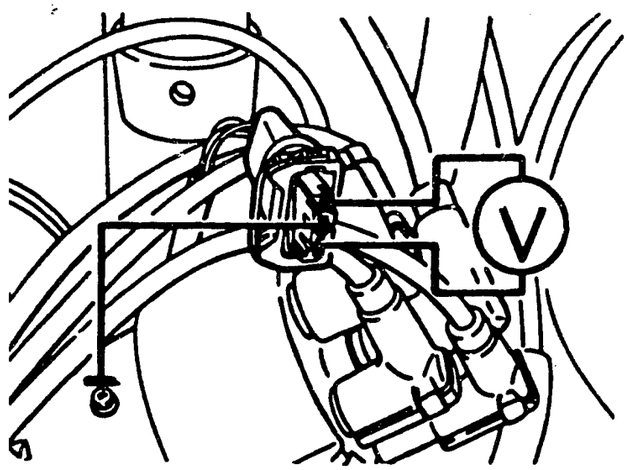
– Flickering of the light-emitting diode when the starting motor is actuated indicates that the Hall generator is operating.

If this is not the case, disconnect the plug of the Hall generator from the ignition distributor and check the voltage supply from the control unit with the ignition switched on (upper illustration).

– The input voltage at the Hall generator must be at least 9 V.

Afterwards, reconnect the plug with the rubber sleeve pulled off. Test the signal of the Hall generator again using a voltage tester, with the starting motor turning (lower illustration).

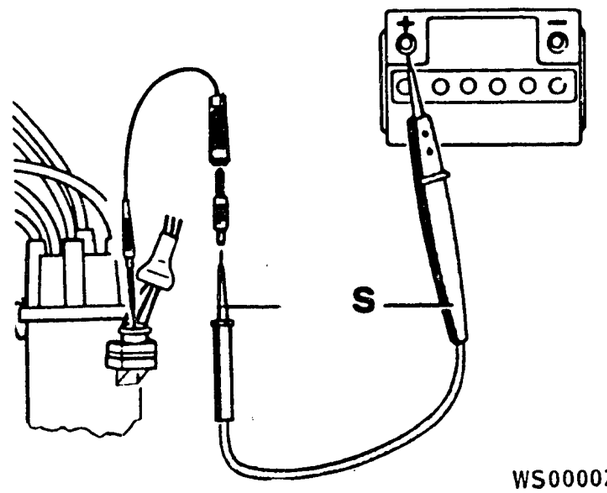
– If the light-emitting diode of the voltage tester does not flicker, the Hall generator and/or the control unit is defective.



WS000020

Checking of the input voltage at the plug of the Hall generator

Functional check of the Hall generator using the voltage tester S at the output of the Hall generator



WS000021

d) Before the output stage is tested, the ignition coil must be checked (see above).

The input voltage of the output stage can be measured using a voltmeter at the disconnected plug (lower illustration).

- Approx. battery voltage must be applied to the output stage. If not, there is probably an open circuit in a lead.

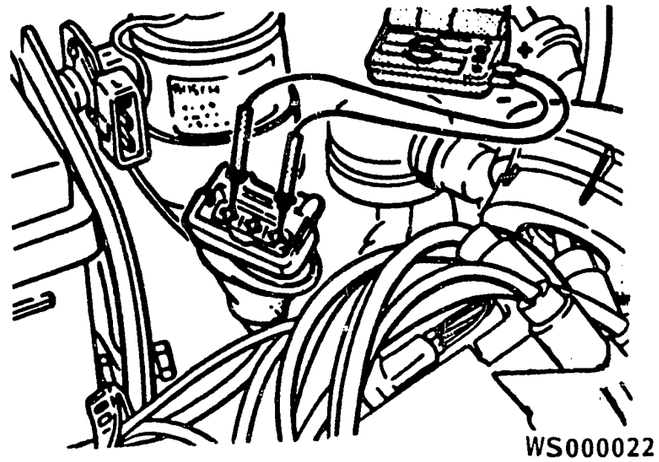
Test the signal from the Hall generator using a voltage tester (see Coordinate 15).

Afterwards, reconnect the plug to the output stage (with the ignition switched off) and disconnect the plug from the Hall generator. Connect a voltmeter to the ignition coil (lower illustration) and switch on the ignition.

- The voltmeter must indicate at least 2 V and drop back to 0 V after 1...2 s.

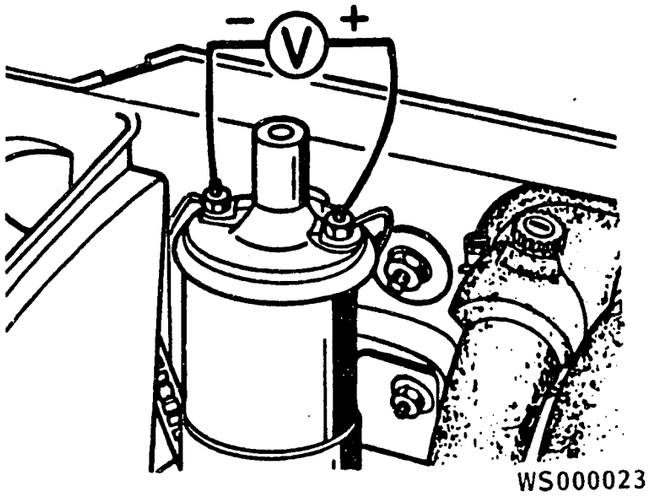
- If the voltage does not drop back, try replacing the output stage and/or control unit and check whether any sealing compound has escaped from the ignition coil. Replace this as well if necessary.

e) Measure the primary and secondary resistances at the ignition coil and check whether any sealing compound has escaped.



Measuring the input voltage at the plug of the output stage

Functional check of the output stage by means of voltage measurement across the ignition coil



6. Work instructions

When tightening the fastening screw of the knock sensor, make sure that you observe the tightening torque of 15...25 Nm , since operation of the knock sensor can be disrupted if it is not mounted properly.

Spark-plug tightening torque = 20 Nm

Electrode gap = 0.7...0.9 mm

7. Technical Data

Engine	Type	2.0 l "PS" - 85 kW
Ignition system	Make/Type	FEI
Firing order		1-2-4-5-3
Cylinder 1		Flywheel
Spark plugs	Make/Type	VW/Audi 191 905 450 A Bosch W7DTC 14-7DTU Champion N7BYC
	Electrode gap	0.7...0.9 mm
Ignition coil	Primary resistance	0.5...1.5
	Secondary resistance	5...9 k Ω
	Spark-plug resistance	4...6 k Ω
	Suppressor resistance	0.6...1.4 k Ω
Ignition point	Test value	16...20° before TDC
	Setting	18 ± 1° before TDC
Idle speed		750...850 min $^{-1}$

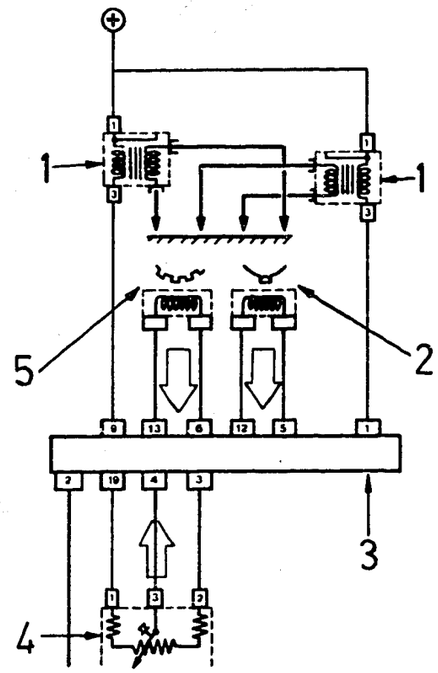
IGNITION SYSTEM

Citroen CX 2500

1. Construction and Operation

The integrated, electronic ignition system (A.E.I.) is an ignition system without ignition distributor. The electronic control unit triggers the ignition sparks on the basis of the three basic pieces of information: engine speed, crankshaft position and intake-manifold pressure.

The spark plugs are split into two groups: cylinders 1 and 4, and 2 and 3. Each group is equipped with one ignition coil. The A.E.I. control unit actuates the respective ignition coil directly and triggers the ignition spark simultaneously at the two spark plugs assigned to the coil.



WS000028

Schematic layout of the A.E.I. ignition system:

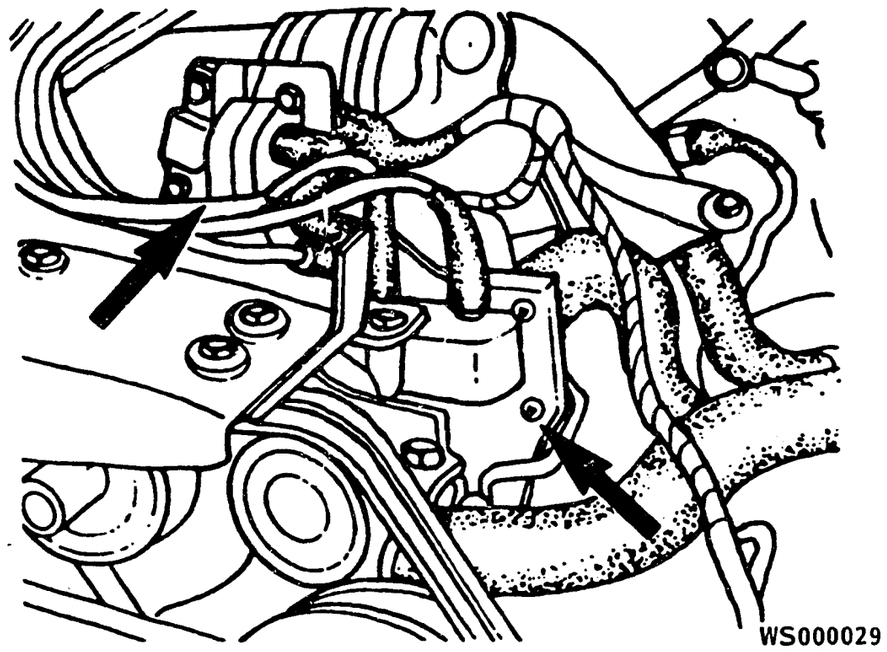
1 = Double-spark ignition coil

2 = TDC or reference-mark sensor

3 = Control unit

4 = Vacuum unit with sensor

5 = Engine-speed sensor



Position of the two double-spark ignition coils:

left-hand ignition coil = cylinders 1 and 4

right-hand ignition coil = cylinders 2 and 3.

The A.E.I control unit also controls the fuel-pump relay and the rev counter. Furthermore, it controls engine-speed limitation and trigger-ing of the injection pulse.

2. Test equipment

The A.E.I. ignition system can be tested using a voltmeter, ohmmeter, a test lamp, and a feeler gauge.

For production reasons:
continued on the following
coordinate.

3. Test specifications for individual components

3.1 The ignition point cannot be adjusted.

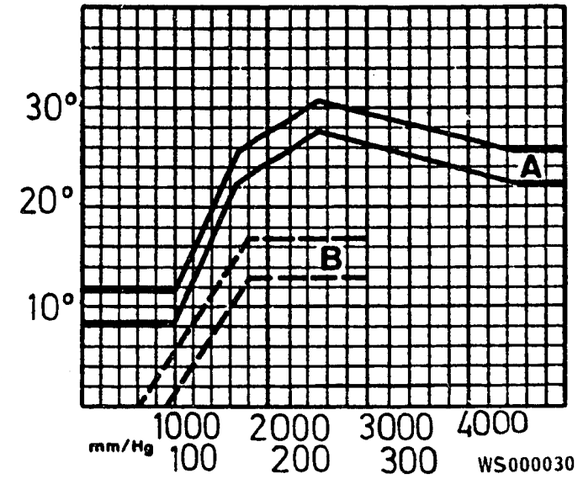
3.2 The timing advance, as a function of the engine speed and intake-manifold pressure, can be tested on the basis of the chart (upper illustration) using a timing strobe.

3.3 In the case of a malfunction, the following procedures are recommended:

a) Check the spark at each cylinder.
If the spark is OK:
- check spark plugs
- test fuel-injection system
- check connecting cable between A.E.I. control unit and fuel-injection control unit for continuity.

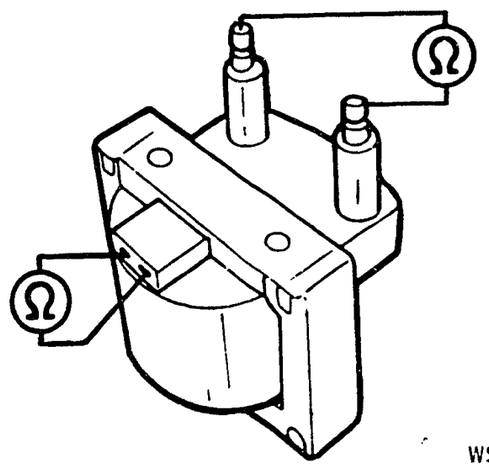
b) If there is no ignition:
- connect test lamp to ignition: (+ and -)
- actuate starting motor
- if the lamp does not flash in a regular pattern, test primary circuit (see 3.3 c, d and e).
- If the lamp flashes in a regular pattern, test secondary circuit (see 3.3 f).

c) Measure primary resistance of the ignition coil:
- resistance between terminals 1 and 9 at the disconnected, black plug of the A.E.I. control unit must be approx. 2.5 Ω



Engine-speed (A) and vacuum (B) adjustment curves

Measuring the primary resistance (left) and the secondary resistance (right) of the double-spark ignition coil



Test specifications for individual components (Continued)

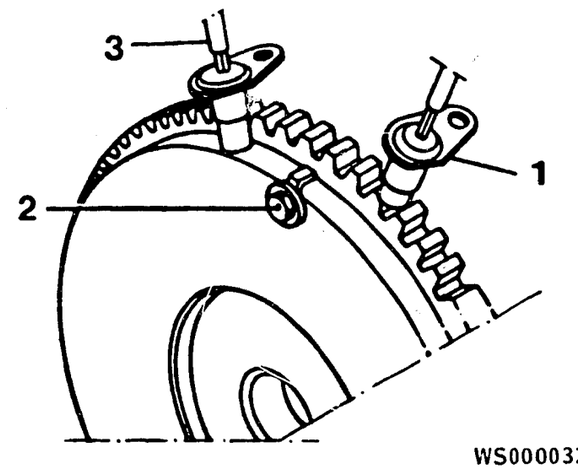
d) Test secondary resistance of the ignition coils:

Set value = 3500 ... 4000 Ω

e) Gauge TDC and engine-speed sensors:

- resistance between terminals 5/12 (TDC sensor) and 6/13 (engine-speed sensor) at disconnected, black plug of the A.E.I. control unit must be approx. 50 Ω in each case.

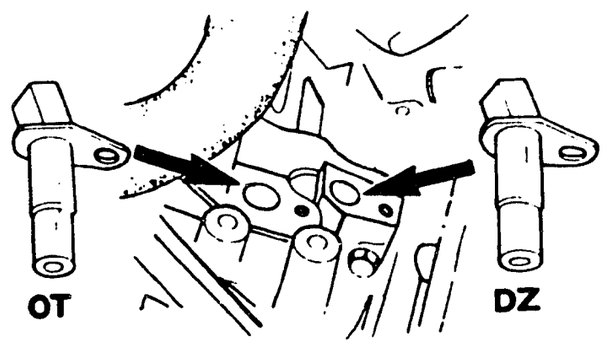
- measure air gap between the sensors and the teeth with respect to the TDC marking on the flywheel.
Set value = 0.5 ... 1.5 mm.



WS000032

Engine-speed sensor (1) and TDC sensor (3) with reference mark (2) on flywheel

Position of the TDC sensor (TDC) and the engine-speed sensor (DZ) on the engine timing housing (left side of vehicle)



WS000033

Test specifications for individual components (Continued)

f) Test power supply and ground of the A.E.I. control unit.
The unit is located on the passenger's side in the glove compartment and is easily accessible.

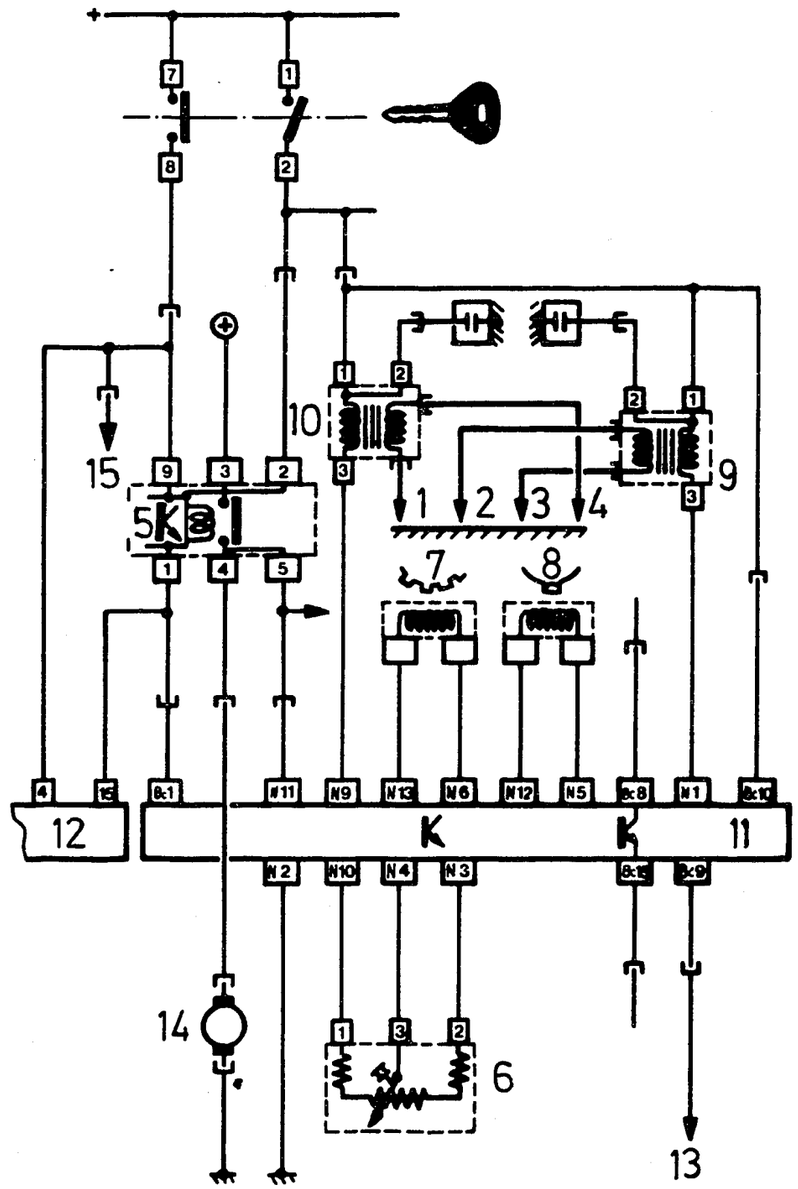
- Measure voltage between terminal 10 (white plug) and terminal 2 (black plug).
  Set value = battery voltage.

- Measure voltage between terminals 2 and 11 (black plug) while starting motor turning.
  Set value = battery voltage.

- Terminal 9 supplies power to the rev counter.
  Note: the supply cable of the ignition coil 1/4 is marked with a red adhesive lable.

4. Technical Data

Engine	Type	2500 i
Ignition system	Type	A.E.I
Firing order		1–3–4–2
Cylinder 1		near flywheel
Spark plugs	Make/Type	Lyquem 755 SX Champion L 82 Y
	Electrode gap	0.8 ... 0.9 mm
Ignition coils	Make	Delco–Remy
	Primary resistance	1...2 Ω
	Secondary resistance	3.5...4.0 k Ω
TDC sensor	Air gap	0.5...1.5 mm
	Resistance	approx. 50 Ω
Engine–speed sensor	Air gap	0.5...1.5 mm
	Resistance	approx. 50 Ω



WS000034

Electrical terminal diagram of the A.E.I. ignition system of the Citroen CX 2500

1 = Spark plug of cylinder 1
2 = Spark plug of cylinder 2
3 = Spark plug of cylinder 3
4 = Spark plug of cylinder 4
5 = Relay, injection
6 = Pressure sensor
7 = Engine-speed sensor
8 = TDC sensor
9 = Ignition coil, cyls 2 and 3
10 = Ignition coil, cyls 1 and 4
11 = A.E.I control unit
12 = Control unit, fuel-inj. system
13 = Rev counter
14 = Fuel pump
15 = Starting-motor sol. op. switch

This microcard was prepared exclusively for Bosch Service on behalf of ROBERT BOSCH GMBH STUTTGART

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto-Technik" magazine published by the AT-Fachschriftenverlag AG, CH-5001 Aarau.

The BOSCH equipment and the test specifications/ settings for BOSCH products and components are always to be taken from the BOSCH microcards. Test specifications and circuit diagrams are contained in the microcards and workshop documentation already introduced into BOSCH after-sales-service workshops.

For production reasons:
continued on the following coordinate.

IGNITION SYSTEM

Lancia Y 10 1000 Turbo, 62 kW

1. Construction and Operation

The Digiplex is a fully electronic ignition system which determines the respective ignition point on the basis of various input signals and in accordance with a characteristic map.

The main variables are the engine speed, crankshaft position and the pressure in the intake manifold.

The pressure sensor, integral in the control unit, is installed in the engine compartment on the right-hand side of the firewall.

The engine speed is picked up by a sensor on the flywheel and the TDC position by a sensor on the crankshaft pulley.

Safety instructions

- Do not start the engine unless the battery terminals are secured tightly
- Do not start the engine using a boost battery charger
- Do not disconnect the battery while the engine is running
- Remove the control unit if temperatures are going to exceed 80° C (stove-enamelling in drying oven)
- Disconnect the battery before carrying out electrical welding work
- Do not disconnect or connect the control-unit plug while the ignition is switched on!

2. Test equipment

The Digiplex can be tested using a voltmeter, ohmmeter, timing strobe and rev counter if the specific FIAT–Lancia tester is not available.

3. Testing the individual components

a) Test the ignition point at idle speed using the timing strobe. The markings are located on the flywheel and clutch housing (upper illustration).

- Set value = 10° ± 2° before TDC:

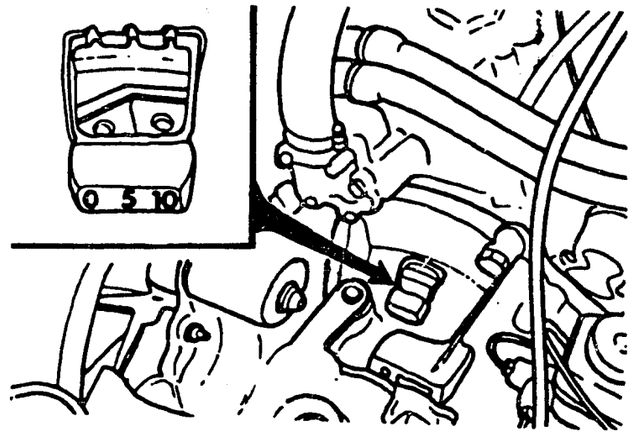
b) Measure resistance of the engine–speed sensor at the disconnected plug of the control unit between terminals 2 and 3 (lower illustration).

- Set value = 612 ... 748 Ω

- If set value not measured, check plug–in connection to sensor and air gap; replace sensor if necessary.

c) Measure resistance of the TDC sensor at the disconnected plug of the control unit between terminals 1 and 5 (lower illustration).

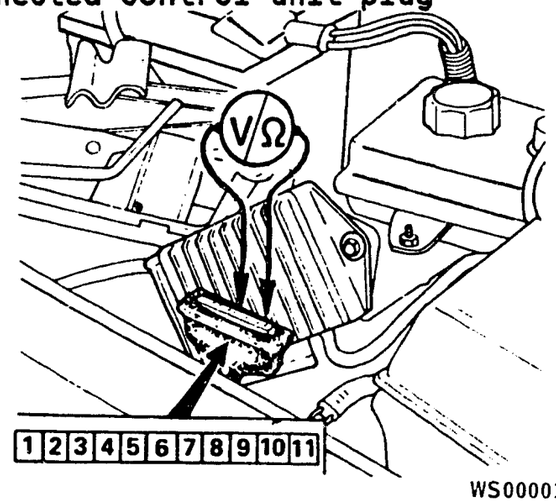
Set value = 612 ... 748 Ω



WS000035

Ignition–point marking on the flywheel and clutch housing.

Voltage measurement and resistance measurement at the disconnected control–unit plug



WS000036

Testing the individual components (Continued)

d) Check air gap between engine–speed sensor and flywheel (upper illustration):

- Set value = 0.25 ... 1.3 mm.

The sensor cannot be adjusted. Check the ring gear on the flywheel for defects or worn teeth.

e) Check air gap between the TDC sensor and crankshaft pulley (lower illustration):

- Set value = 0.4 ... 1.0 mm.

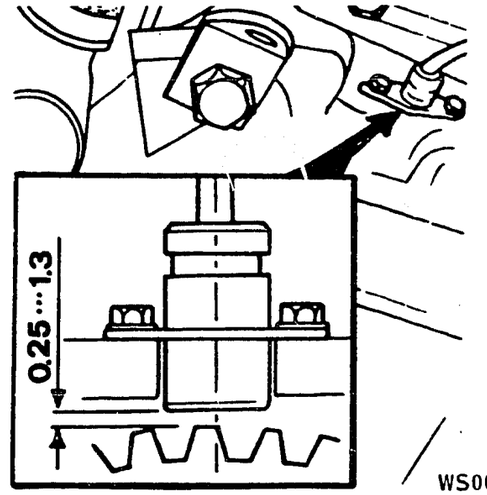
f) Check the resistance of the ignition coil. The values are valid at 20° C:

- Primary resistance = 0.310 ... 0.378 Ω
- Secondary resistance = 3.330 ... 4.070 k Ω

g) Check the power supply and ground terminal at the control unit itself. Before disconnecting the plug, make sure that you switch off the ignition.

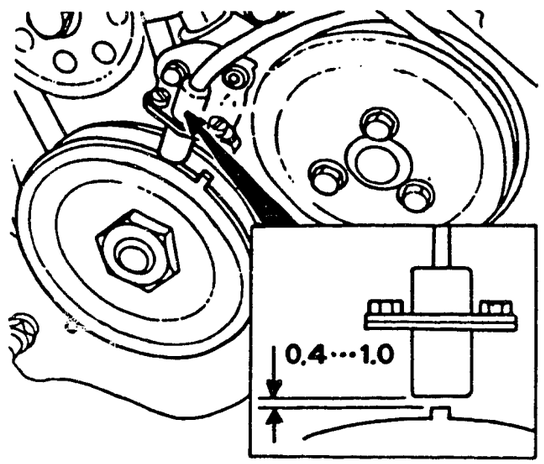
- Power supply: battery voltage between terminals 9 and 11 when switching on the ignition. If battery voltage is not measured, check cable for open circuit.

- Ground: battery voltage between terminals 8 and 9 when switching on the ignition. If battery voltage is not measured, check cable for open circuit.



Air gap between engine–speed sensor and flywheel teeth

Air gap between crankshaft pulley and TDC sensor.

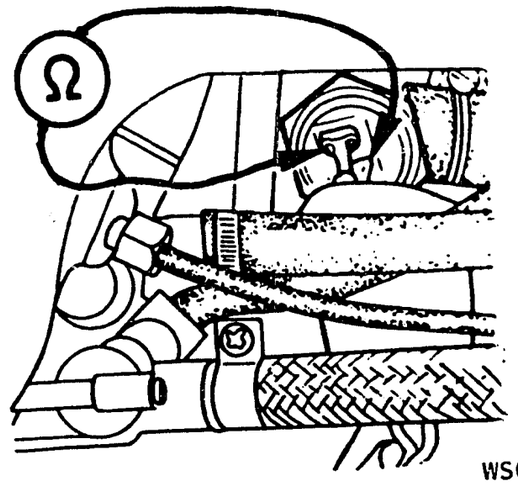


Testing the individual components (Continued)

h) Test pressure switch (upper illustration):
disconnect cable and connect ohmmeter.
The switch must be open or closed;
i.e. resistance = infinity Ω or less than 1 Ω

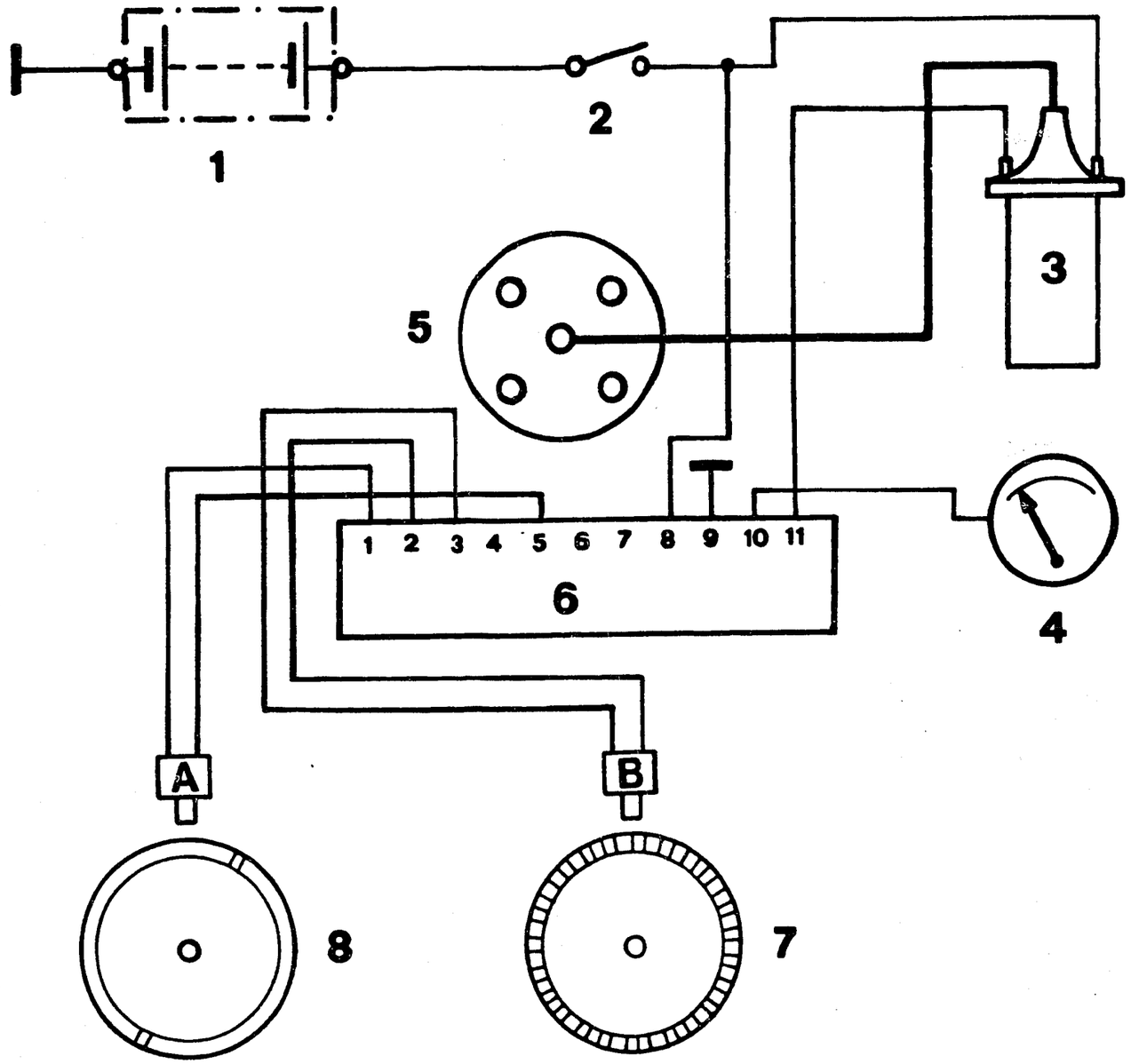
4. Work instructions

The TDC sensor at the crankshaft pulley cannot be adjusted. The exact TDC position for the sensor can be determined by removing the cylinder head and measuring the piston stroke.



WS000039

Resistance measurement at the pressure sensor.



WS000040

5. Electrical terminal diagram

1 = Battery
2 = Ignition lock
3 = Ignition coil
4 = Rev counter
5 = Ignition distributor
6 = Control unit
7 = Engine-speed sensor
8 = TDC sensor

6. Technical Data

Engine	Type	1000 c, Turbo
	Power	62kW/5750 min $^{-1}$
Ignition system	Make	Magneti Marelli
	Type	Digiplex
Firing order		1–3–4–2
Cylinder 1		cylindrical–gear end
Spark plugs	Champion	RN 3C
	Electrode gap	0.6...0.7 mm
Ignition coil	Primary resistance	0.310...0.378 Ω
	Secondary resistance	3.330...4.070 k Ω
Ignition distributor	Make	Magneti Marelli
	Type	DT 404 AX
	Rotor resistance	1.0 k Ω
	Ignition–cable resistance	25 k Ω

Technical Data (Continued)

Ignition point	at idle speed	10° ± 2° before TDC
Idle speed		750 ± 50 min $^{-1}$
Engine–speed sensor	Make	M.Marelli SEN 8E
	Resistance	612...748 Ω
	Air gap	0.25...1.3 mm
TDC sensor	Type	M.Marelli SEN 8D
	Resistance	612...748 Ω
	Air gap	0.4...1.0 mm
Control unit	Make	Magneti Marelli
	Type	MED 410 A

This microcard was prepared exclusively for Bosch Service on behalf of ROBERT BOSCH GMBH STUTTGART

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto-Technik" magazine published by the AT-Fachschriftenverlag AG, CH-5001 Aarau.

The BOSCH equipment and the test specifications/ settings for BOSCH products and components are always to be taken from the BOSCH microcards. Test specifications and circuit diagrams are contained in the microcards and workshop documentation already introduced into BOSCH after-sales-service workshops.

For production reasons: continued on the following coordinate.

Lancia Y 10 / 1000 Fire 4 WD-37 kW /
Autobianchi Y 10, 33 kW /
Fiat Uno / Fiat Panda

1. Construction and Operation

The electronic ignition system from Marelli operates as a breakerless TCI with induction-type pulse generator in the ignition distributor.

The trigger box is mounted directly on the ignition distributor with a spacer.

Adjustment of the ignition point is by means of vacuum and centrifugal force in the ignition distributor that is mounted directly on the cylinder head.

2. Test equipment

A voltmeter, ohmmeter, rev counter and timing strobe are required for testing the ignition system.

For production reasons:
continued on the following
coordinate.

3. Testing the individual components

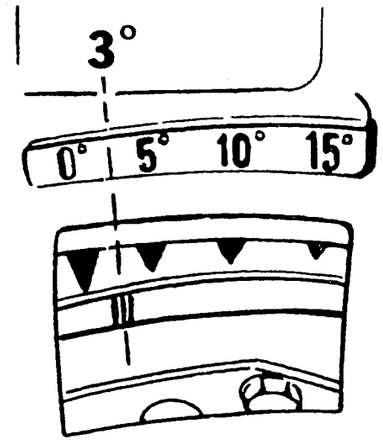
a) The transistorized trigger box may be replaced only after all the other components of the ignition system have been checked and the following test procedures have been carried out.

b) For checking the ignition point, disconnect the vacuum hose from the vacuum control unit and seal off the hose.
The ignition point is set by turning the ignition distributor.

- The markings are located on the flywheel and the clutch housing (upper illustration).
- Ignition point at idle speed (750 min $^{-1}$) = 2° before TDC.

c) The input voltage at the ignition coil and control unit must, with the ignition switched on, correspond to the battery voltage (lower illustration).

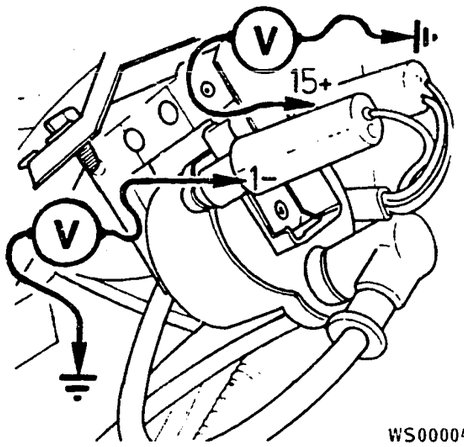
- If no voltage is applied to terminal 15, check the lead from the ignition lock.
- If there is no voltage at terminal 1, check the ignition coil.



WS000041

Ignition-point marking on the clutch housing and flywheel.

Checking the input voltage at the ignition coil.



WS000042

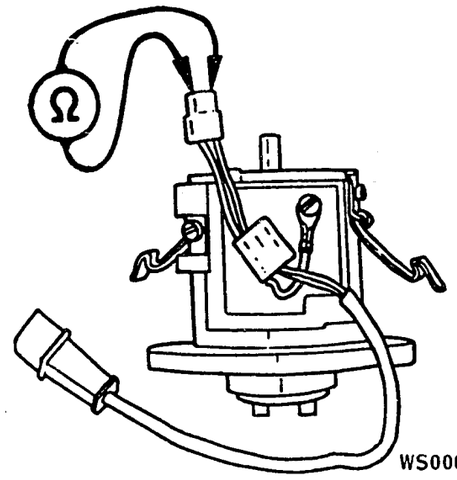
Testing the individual components (Continued)

d) The TCI trigger box must be tested using an ohmmeter to see if it has a good connection to ground.

e) For testing the resistance and for testing for short circuit to ground of the pulse generator, remove the ignition distributor and the trigger box. The air gap between the rotor and generator cannot be adjusted.

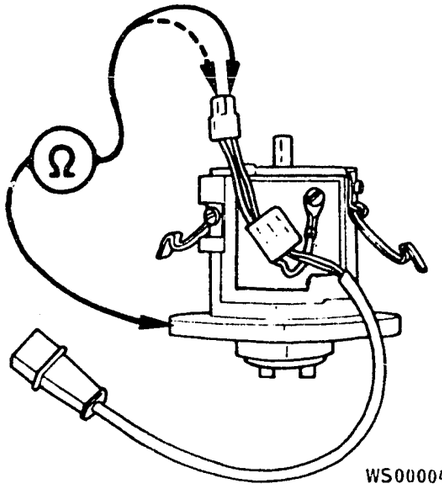
- Resistance of the pulse-generator coil = 758 ... 872 Ω (upper illustration).

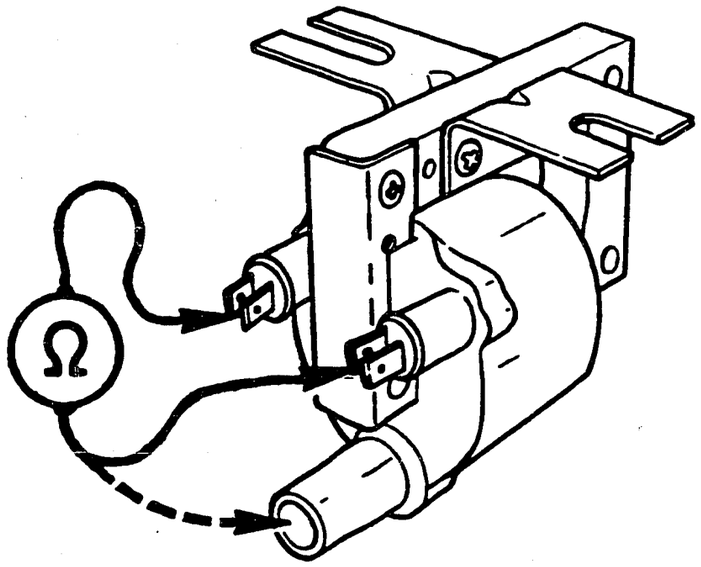
- Resistance of the pulse-generator coil to housing ground = infinity Ω (lower illustration).



Resistance measurement at the pulse-generator coil

Checking the pulse-generator coil for short circuit to ground





WS000045

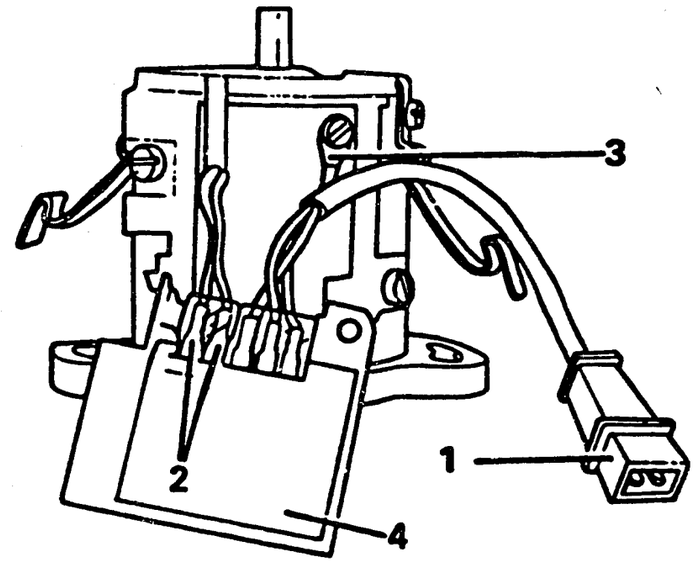
Resistance measurement at the ignition coil:

Primary and secondary windings

Testing the individual components (Continued)

e) The ignition-coil resistances must be measured with the plug disconnected. Resistance values at 20°C:

- Primary resistance = 0.75...0.92 Ω (illustration)
  Secondary resistance = 3.33...4.07 k Ω (illustration).



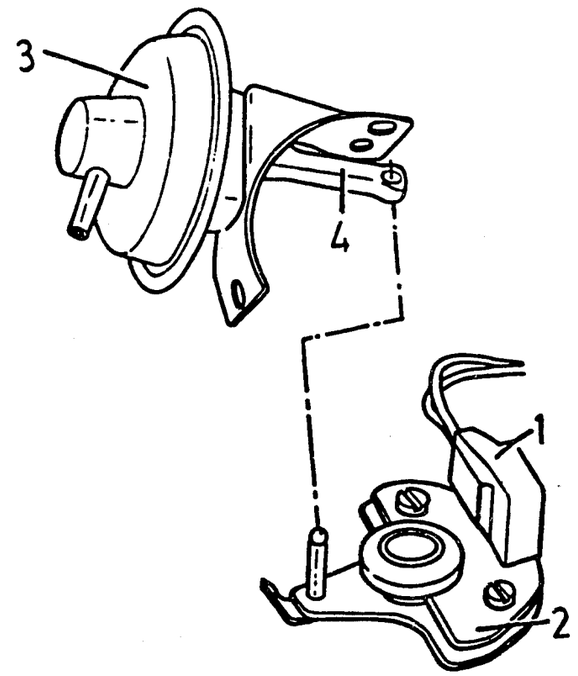
WS000046

Removal of the TCI trigger box:

1 = Plug
2 = Plug-in connections to pulse generator
3 = Ground on housing
4 = TCI trigger box

4. Work instructions

a) When removing the TCI trigger box, mark the plug before removing it and be very careful when plugging it back together again.
  Make sure that the ground terminal is not frayed, since the result of contact with the current-carrying terminal next to it would be a short circuit (upper illustration).



WS000047

Removing the pulse generator:

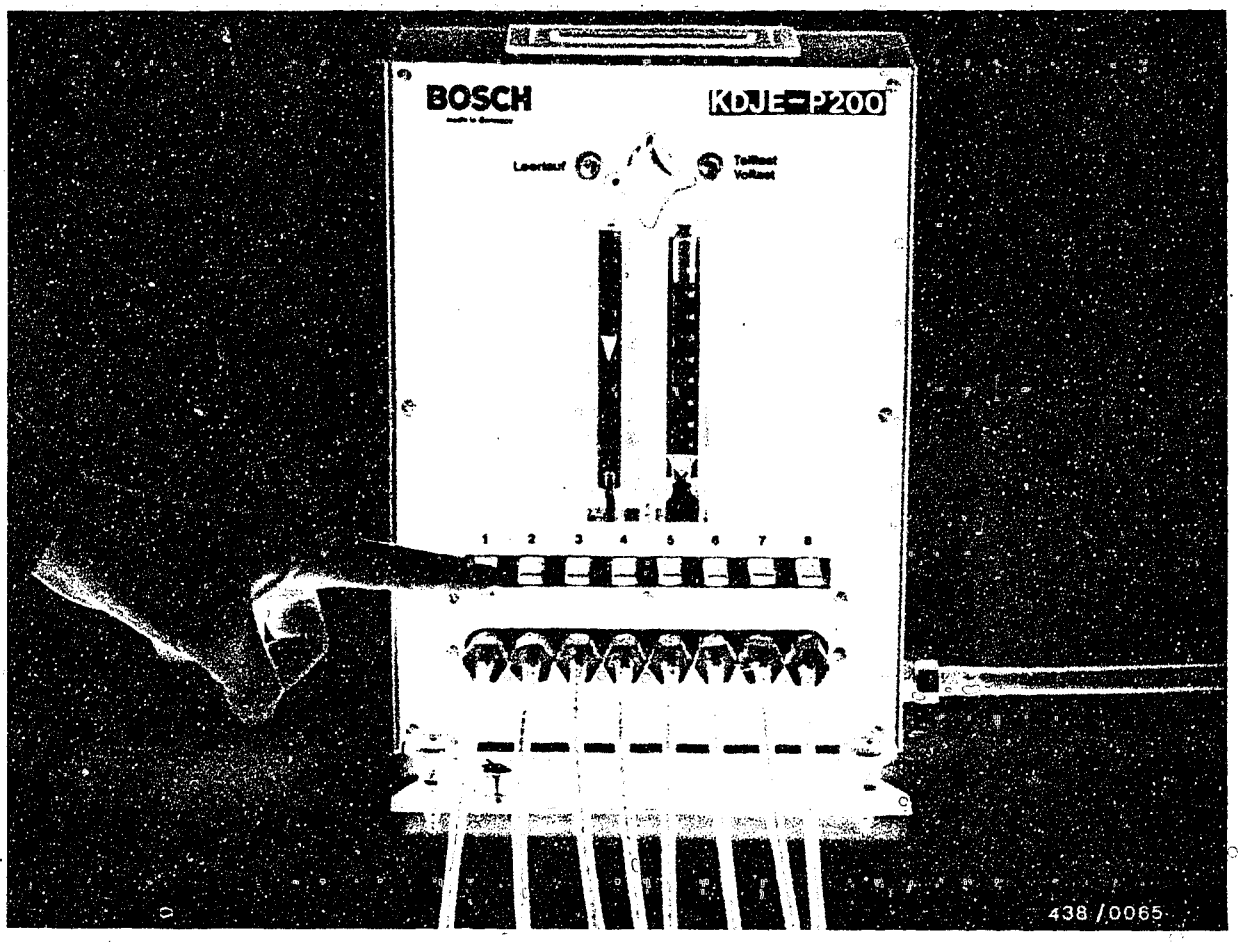
1 = Pulse generator
2 = Carrying plate
3 = Vacuum control unit
4 = Control lever

Work instructions (Continued)

b) Removal of the pulse generator involves loosening the TCI trigger box and removing the vacuum control unit. The carrying plate can then be removed together with the generator from the ignition distributor (illustration).

5. Technical Data

Engine	Type	1000 cc
	Power	33kW/5250 min $^{-1}$ Type 4WD = 37kW/5500 min $^{-1}$
Ignition system	Make	Magneti Marelli
	Type	TCI with induction-type pulse generator
Firing order		1-3-4-2
Cylinder 1		timing-housing end
Spark plugs	Bosch	FR7 DC
	Electrode gap	0.7...0.8 mm
Ignition coil	Primary resistance	0.75...0.92 Ω
	Secondary resistance	3.33...4.07 k Ω
Ignition distributor	Make	Magneti Marelli
	Type	SE 101 A
Pulse generator	-Resistance	758...872 Ω
	-Air gap	0.3...0.4 mm
Ignition point (vacuum hose disconnected)	at idle speed	2 ± 2° before TDC
Timing advance	maximum	28 ± 2° before TDC
Idle speed		850 ± 50 min $^{-1}$



Press the key for outlet 1. Pivot the air-flow sensor plate until the corresponding rotameter tube approximately indicates the "set point" value. Fix the air-flow sensor plate in this position.

Test the remaining outlets in order to determine which outlet has the lowest fuel delivery.

Press the key for this outlet again, and set the delivery precisely to the "set point" by correcting the position of the air-flow sensor plate. Then fix the air-flow sensor plate in this position again.

Press the remaining keys one after the other, and determine the maximum fuel delivery of each outlet. A deviation in fuel delivery can only be above the "set point".

This microcard was prepared exclusively for Bosch Service on behalf of ROBERT BOSCH GMBH STUTTGART

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto-Technik" magazine published by the AT-Fachschriftenverlag AG, CH-5001 Aarau.

The BOSCH equipment and the test specifications/ settings for BOSCH products and components are always to be taken from the BOSCH microcards. Test specifications and circuit diagrams are contained in the microcards and workshop documentation already introduced into BOSCH after-sales-service workshops.

For production reasons: continued on the following coordinate.

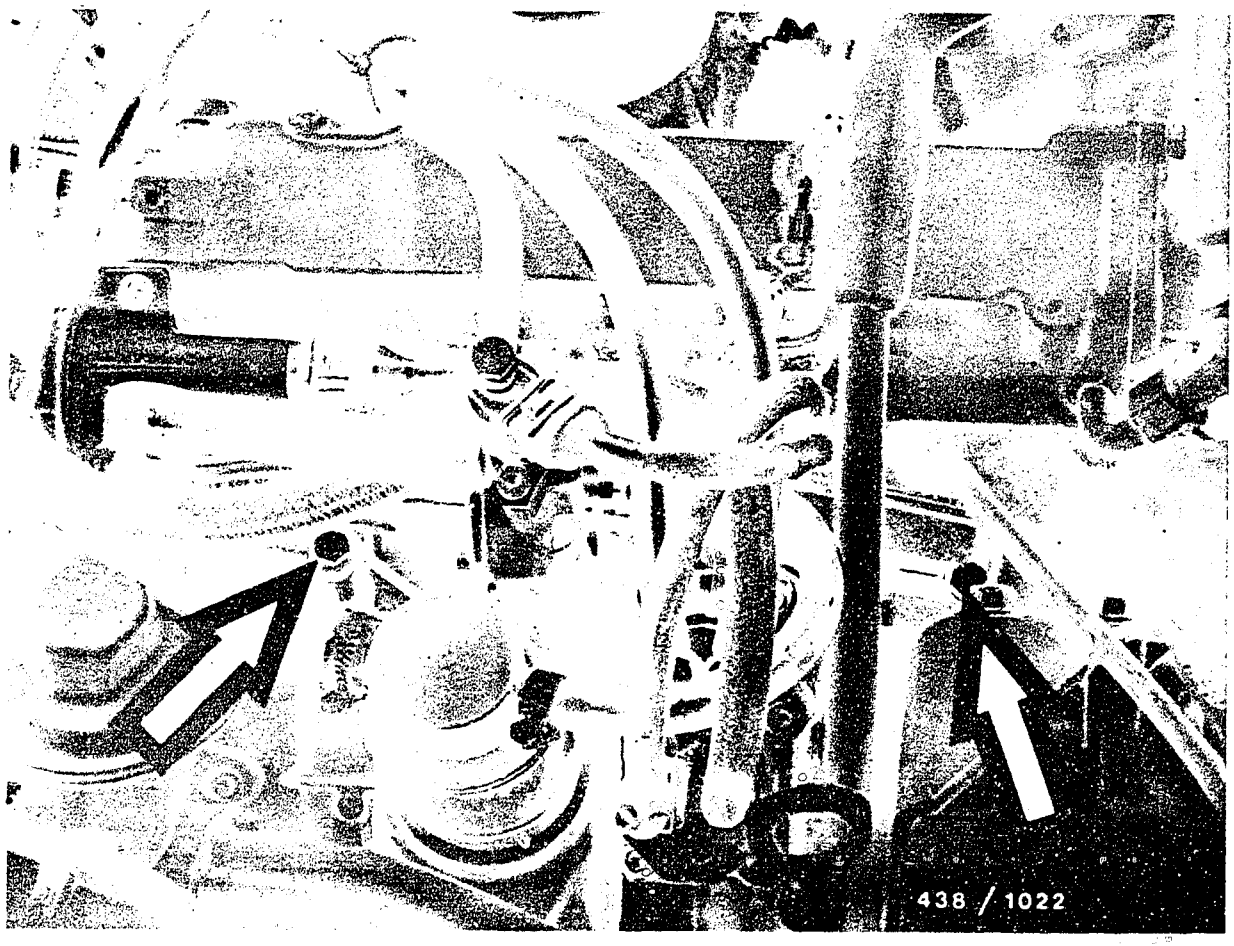
If, in testing, a too large difference is ascertained in one of the three load ranges, the test should for safety's sake be repeated.

If the result is confirmed, you should check whether the fault lies in the fuel distributor or in the injection valves.

To do this interchange the injection valves with the greatest and smallest difference.

If the result is still the same, the fault is in the fuel distributor. If the fault follows the interchanged injection valves, it lies in the injection valves.

Change defective fuel distributor and/or replace defective injection valves.



Before installing the injection valves, check the condition of the rubber cup seals. Defective, cracked or swollen cup seals must be replaced (Volvo service part).

When installing, make sure that the injection valves are properly seated. The spring clamps must latch in.

Re-install the air dome (to the air filter) and finally check the idle adjustment. Adjust if necessary.

Idle adjustment is described on Coordinate F 13.

19. Idle-speed adjustment

19.1 Test conditions:

Warm the engine for adjusting the idle speed (oil temperature approx. 80° C).

Important note:

If the fuel-injection tubing or injection valves were loosened or removed, the engine should be warmed up under load. The low rate of fuel flow during idling is not always adequate to drive all the air out of the fuel-injection tubing.

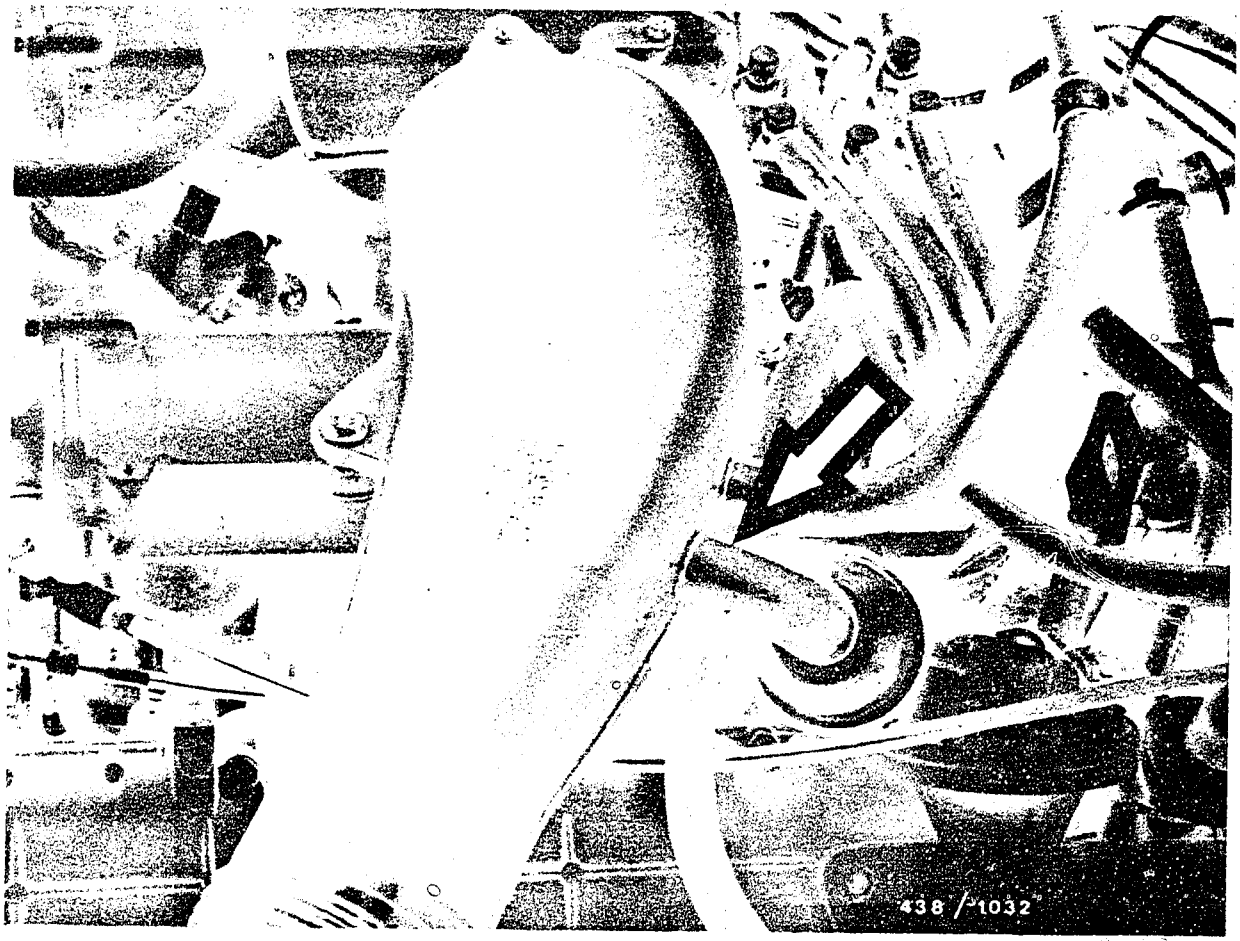
The idle speed must not be adjusted when the engine is too hot, e.g. immediately after being raced or after a power measurement on the roller-type test stand.

In vehicles with an air-conditioner, this should be switched off to stabilize the engine speed during idle-speed adjustment.

Rotational-speed measurement with separate tester.

Exhaust-gas sampling at the exhaust tail pipe.

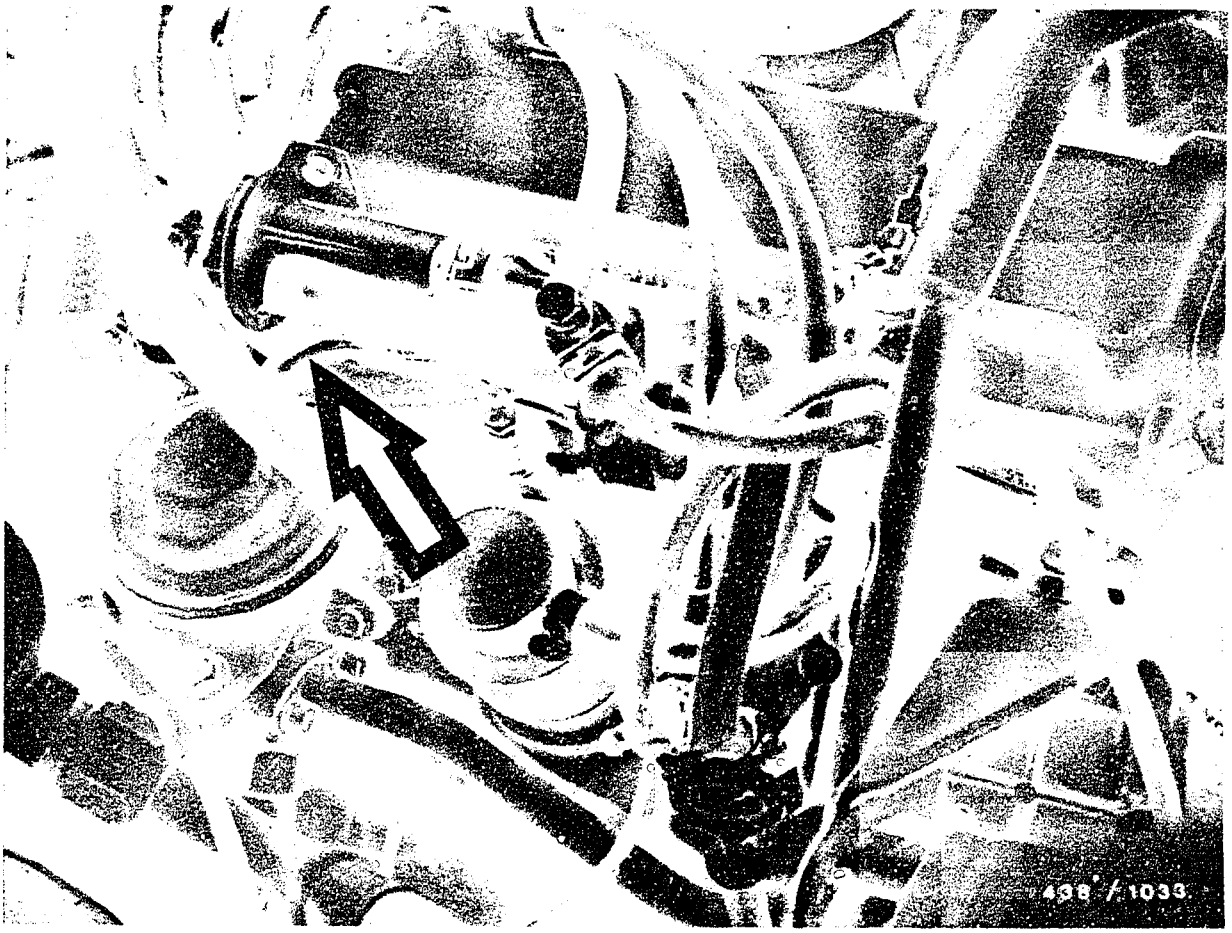
Idle testing and adjustment with air filter connected.



Additional test conditions for Sweden and Australia models:

In order to test and adjust the idle setting, it is necessary to suppress the operation of the "Puls-air" system and of the exhaust-gas recirculation system.

To suppress the operation of the "Puls-air" system, remove the hose line for fresh-air feed from the air dome (arrow) and seal off tight with a plug.



To suppress the operation of the exhaust-gas re-circulation system, remove the vacuum-control line from the EGR valve (arrow) and seal off tight.

19.2 Test specifications for idle adjustment

Idle speed

All models:	900 min^{-1}

CO concentration *

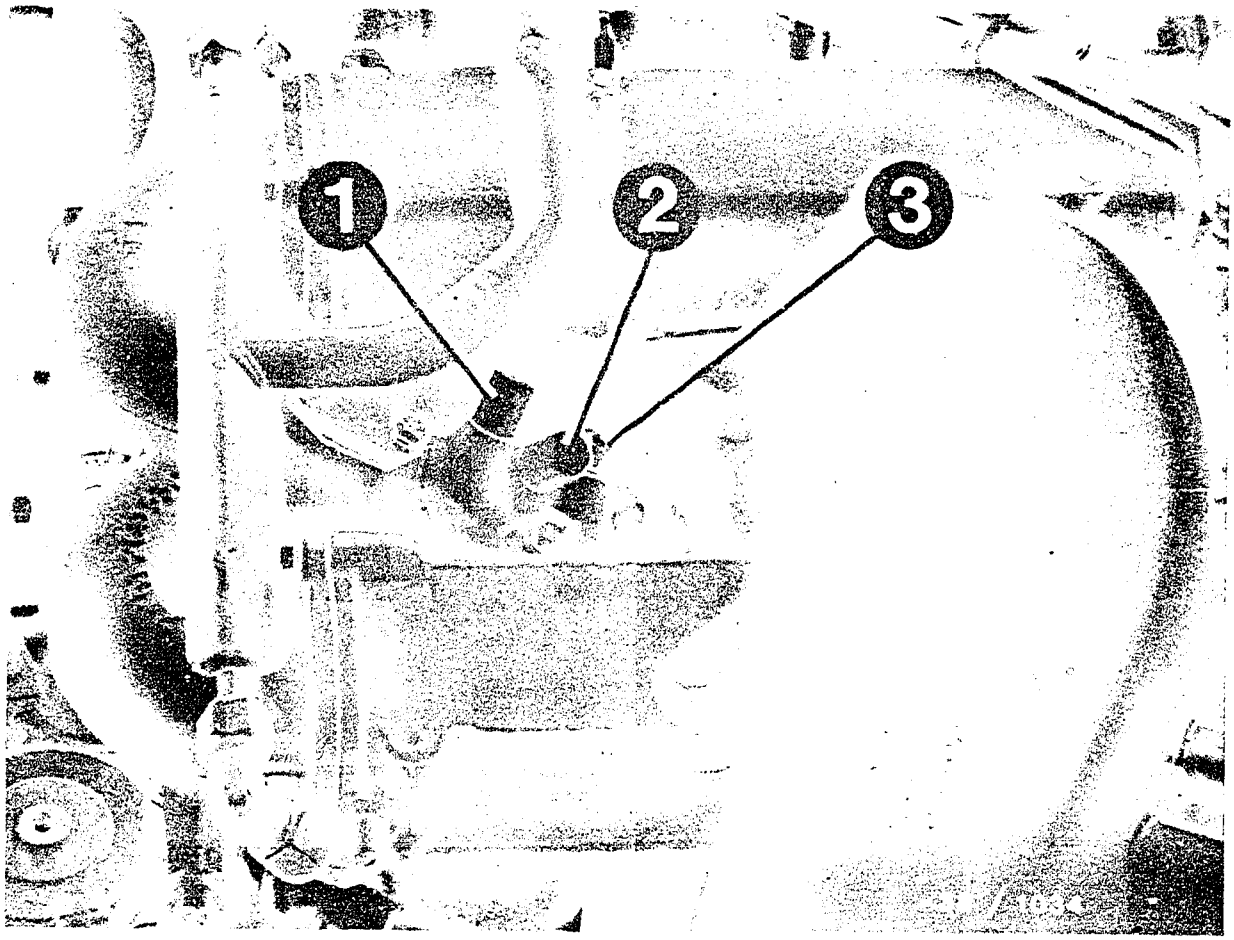
Checking value

All models:	1.0...3.0 % by vol. CO

Setting value

All models:	2.0% by vol. CO

* Engines whose CO concentration is within the checking tolerance need not be re-adjusted if otherwise running smoothly.
If the CO concentration is outside the checking tolerance, adjust to the setting value.



19.3 Adjusting the idle speed

There are three adjusting screws in the throttle housing:

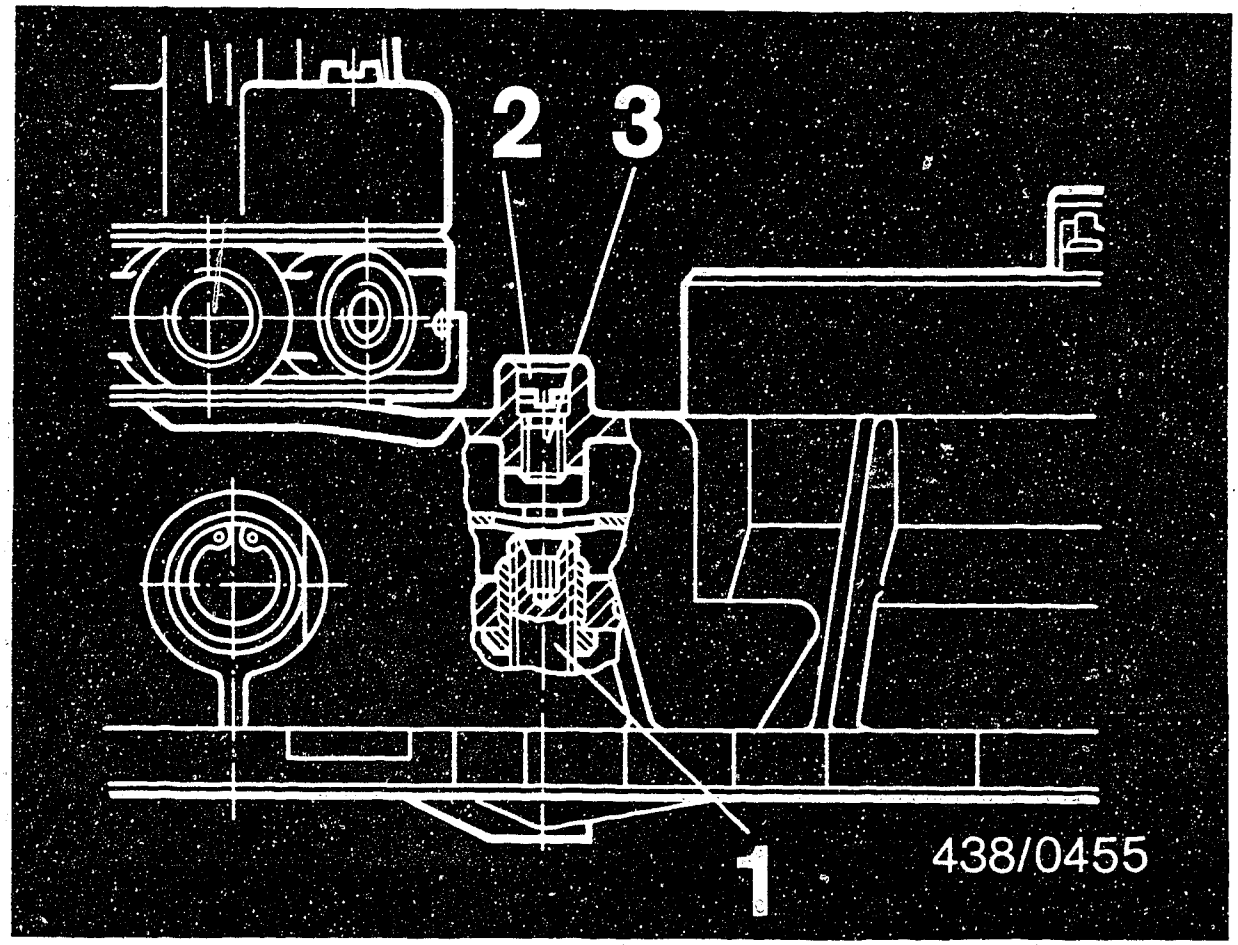
Screw 1 for the right-hand cylinder bank

Screw 2 for the left-hand cylinder bank

Screw 3 for the overall adjustment

Note:

The right-hand intake manifold leads to the left-hand cylinder bank and vice-versa.
Screw 3 is, therefore, the adjusting screw for adjusting the idle speed of the engine. Screws 1 and 2 were set at the factory and must not be changed.



19.4 Adjusting the CO concentration

Adjust the CO concentration by turning the idle-mixture-adjusting screw (1) in the mixture-control unit using the setting wrench KDEP 1035.
The idle-mixture-adjusting screw is accessible after removing the safety plug (2) and the screw plug (3) in the air-flow sensor housing. The anti-tamper device is removed and fitted using special tools (e.g. set of tools No. 4521/7 from Hazet, 5630 Remscheid).
The setting wrench KDEP 1035 is inserted through the housing bore into the idle-mixture-adjusting screw.

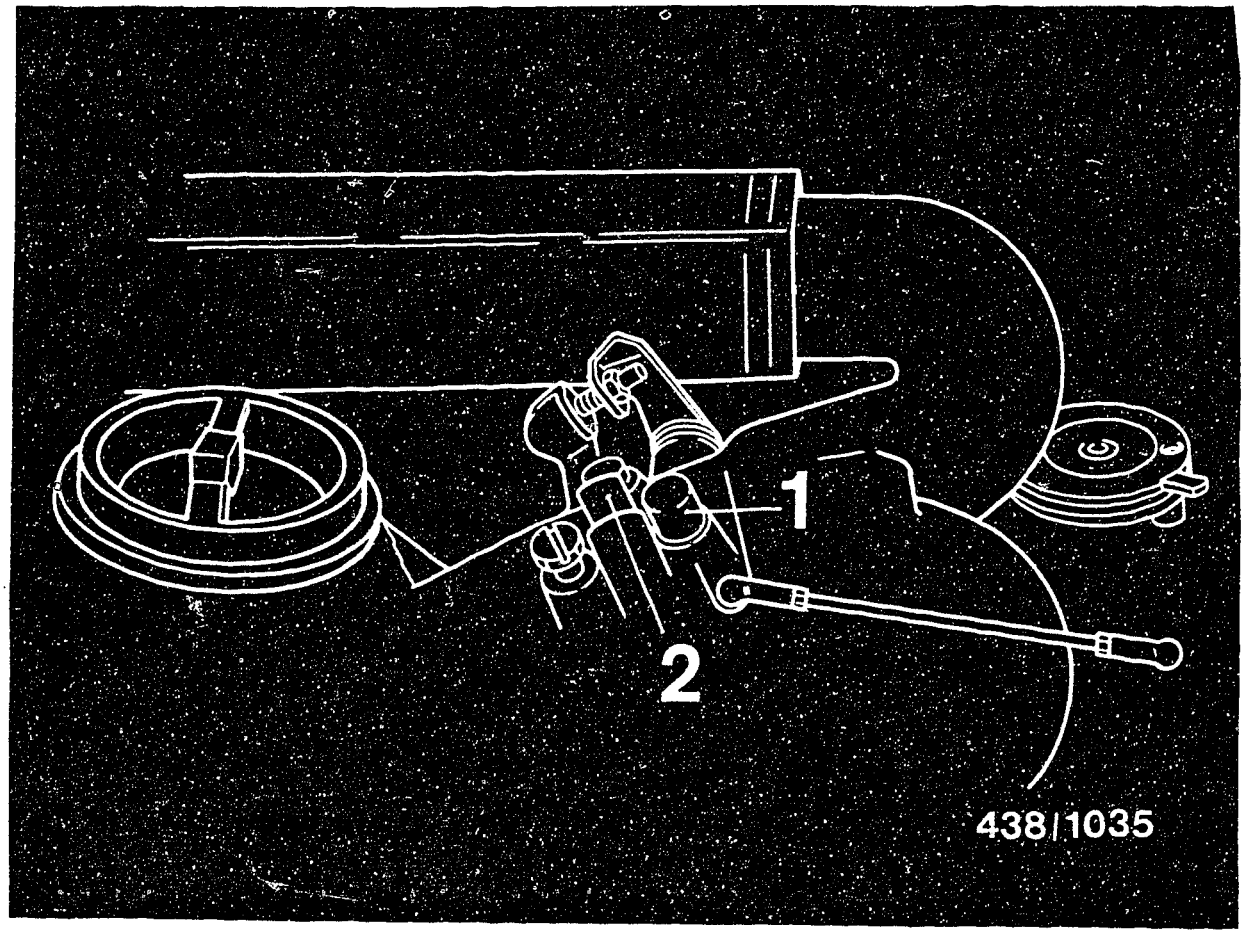
Turning to the right = enriches the mixture
Turning to the left = leans the mixture

Caution:

Always make the adjustment from the lean side, i.e. if the setting too rich, first of all turn the idle-mixture-adjusting screw more than necessary in a counterclockwise direction and then turn in a clockwise direction to the required setting.

Remove the adjusting wrench after each adjustment and seal off the bore to the idle-mixture-adjusting screw. If the bore were open, unmetered air would be drawn in in the case of the downdraft air-flow sensor, thus making the measurement result incorrect.

Accelerate the engine briefly after each adjustment so that the intake passages cool down. Then wait until the reading on the CO analyzer has settled.

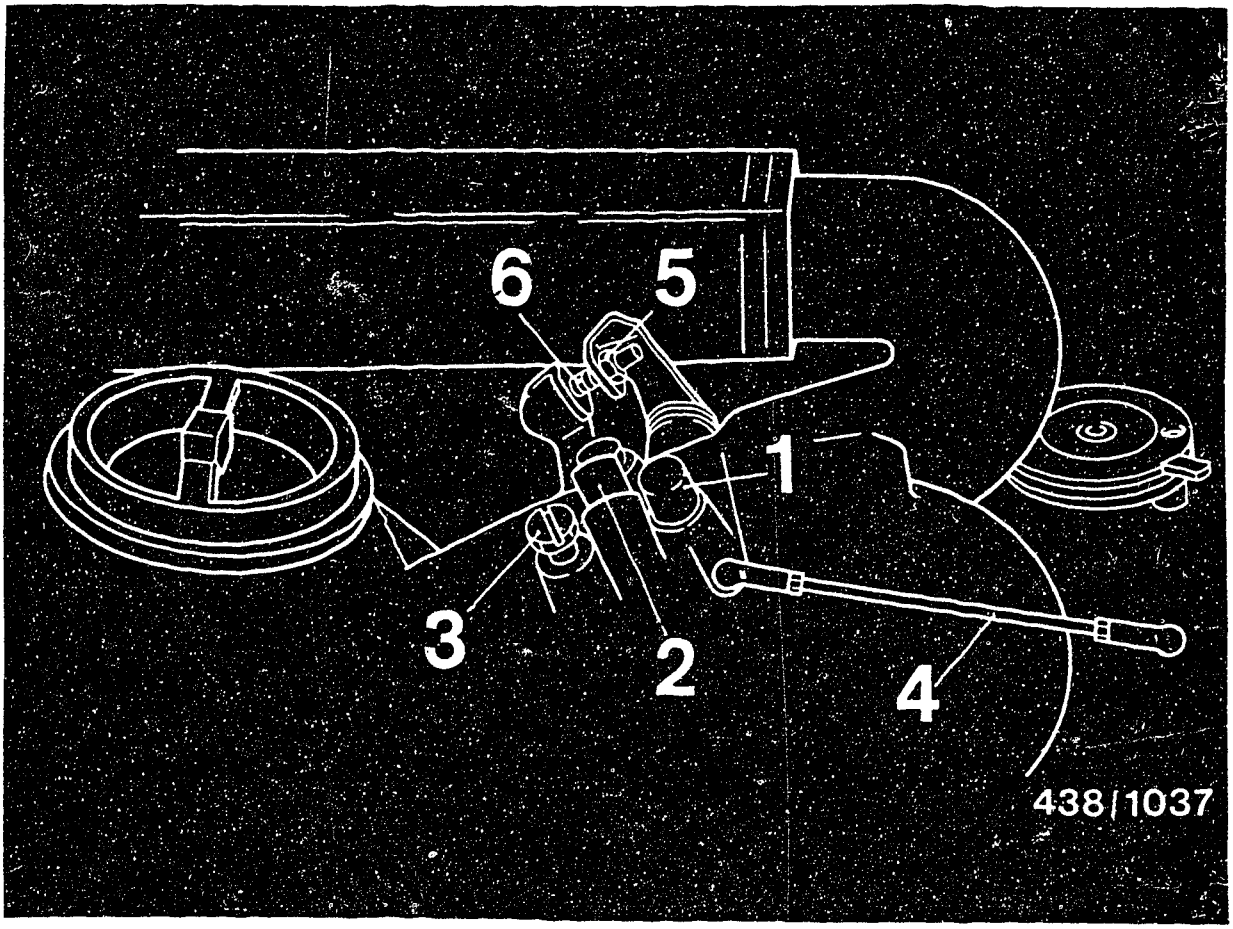


19.5 Additional adjustment information

If, while complying with the specified idle values, it is not possible to obtain correct running of the engine, carry out a basic adjustment of screws (1) and (2) as well as of the throttle-control device.

Basic adjustment of screws (1) and (2):

After removing the anti-tamper caps, screw in both screws as far as they will go, then turn back by 3.5... 4 turns. The same setting for both screws is important.



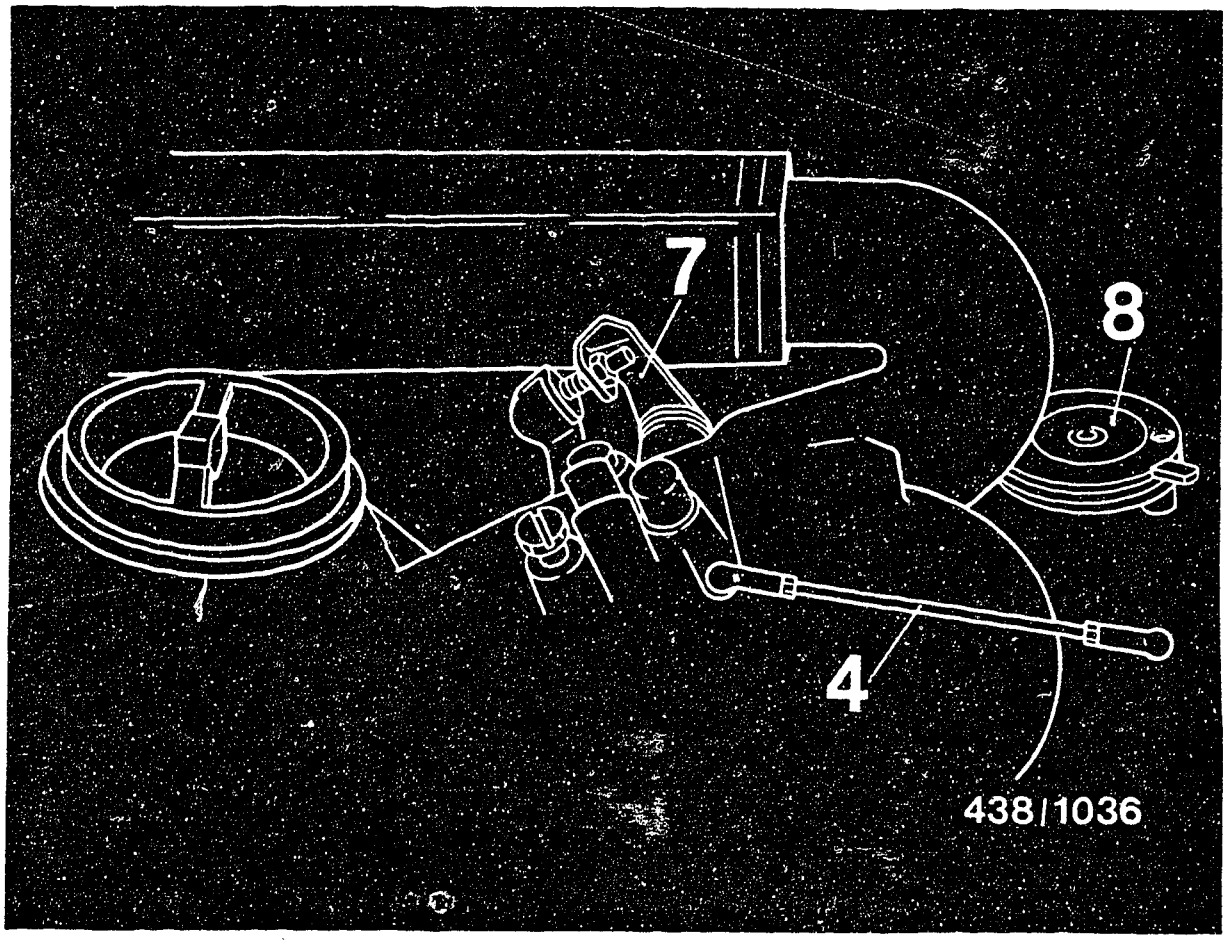
Throttle-control device:

Unhook the pushrod (4) between cable drum and throttle lever. Loosen lock nut (5) of throttle-valve stop screw (6).

Run engine at idle and screw in screw (3) as far as it will go.

Adjust engine speed to n = 700 min^{-1} by turning the throttle-valve stop screw (6) and lock with lock nut.

Set the specified idle speed (n = 900 min^{-1}) with screw (3).



Pushrod:

Adjust the length of the pushrod (4) so that when it is plugged onto the ball pins neither the throttle lever (7) nor the cable drum (8) are moved out of their rest positions.

Throttle-control cable:

In the idle position the cable drum must run back as far as the drum stop. The throttle cable must remain stretched without the cable drum being moved out of its rest position. At full throttle the cable drum must be up against the full-throttle stop.

19.5 Anti-tamper device for idle-mixture screw:

In the Federal Republic of Germany, in accordance with an order for amending the Road Traffic Registration Code, § 47, Exhaust Gases and Their Discharge, has been amended. This order was printed in full in the Verkehrsblatt 13 of 15 July 1975.

Accordingly, all motor vehicles with externally supplied ignition produced as of 1 October 1976 must be provided with anti-tamper devices for the idle-mixture-adjusting screw so that it is not possible to adjust the screw without destroying the anti-tamper device. The intention is to prevent non-experts from re-adjusting the idle setting and thus inadmissibly influencing the exhaust gas. Consequently, the anti-tamper caps may only be used in the workshop and must not be sold to customers for their own use.

These anti-tamper caps come in different colours. Use the following cap and colour for the after-sales service:
In the downdraft air-flow sensor:
Blue anti-tamper cap (not obtainable from Bosch).
Part No. of Daimler Benz 000.997. 5986
Of Deutsche Vergaser Gesellschaft: K 34 520

The housing bore (for receiving the adjusting wrench) is sealed by a plug.
The anti-tamper device is removed and fitted using special tools (e.g. tool set No. 4521/7 from Hazet Co., 5630 Remscheid).

Fiat Tipo 1100, 41 kW

Fiat Tipo 1400, 51 – 52 kW

1. Construction and Operation

The electronic ignition system from Marelli operates as a breakerless TTI with an inductive-type pulse generator installed in the ignition distributor.

The trigger box is mounted directly on the ignition distributor with a spacer.

Adjustment of the ignition point is by means of vacuum and centrifugal force in the ignition distributor. The distributor is mounted on the cylinder head on the 1.1 l engine and on the side of the engine block on the 1.4 l engine.

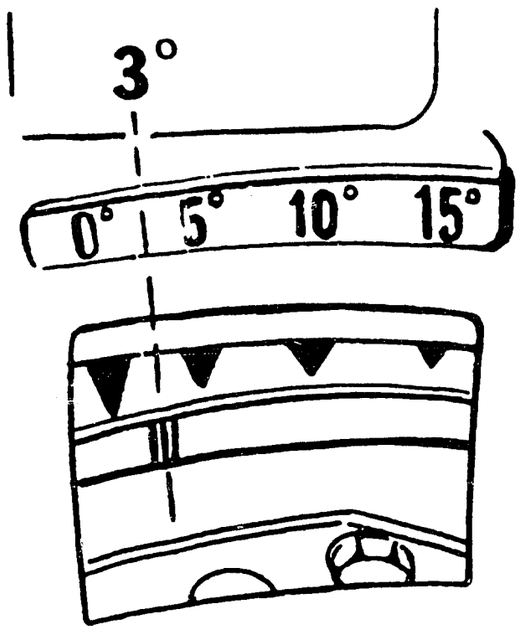
2. Test equipment

A voltmeter, ohmmeter, rev counter and timing strobe are required for testing the ignition system.

3. Testing the individual components

a) The transistorized trigger box may be replaced only if all the other components of the ignition system have been checked and the following test procedures have been carried out.

b) For checking the ignition point, disconnect the vacuum hose from the vacuum control unit and seal off the hose. The ignition point is set by turning the ignition distributor.



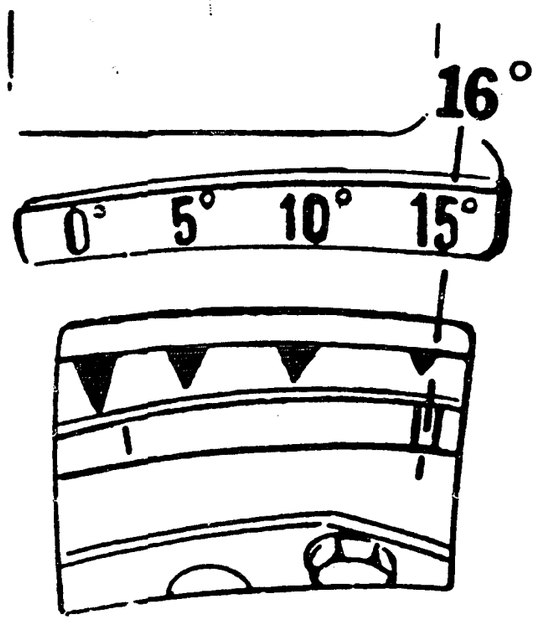
WS000041

Ignition-point markings Tipo 1100

The markings are located on the flywheel and clutch housing (upper illustration).

Ignition point at idle speed

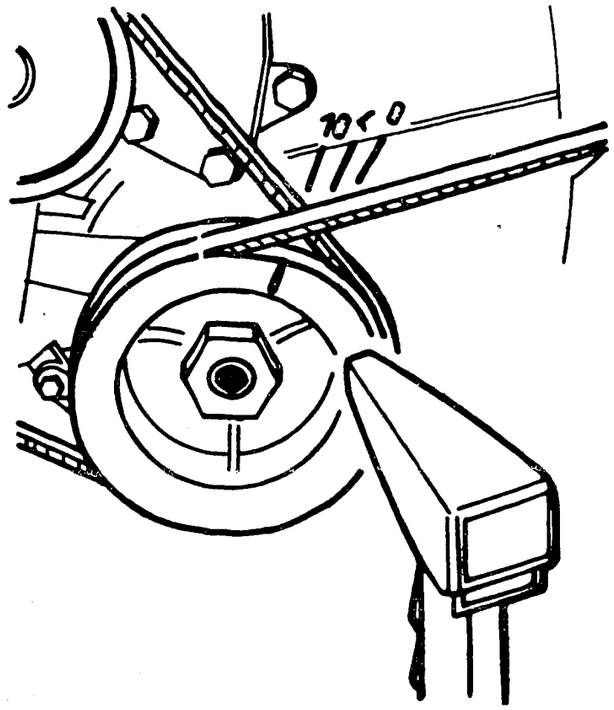
(750 ... 800 min $^{-1}$) = 3° before TDC,
vacuum hose disconnected.



WS000048

Ignition-point markings Tipo 1100

When the vacuum hose is connected, the ignition point (at idle speed) must adjust to 16 ± 2° before TDC (illustration).

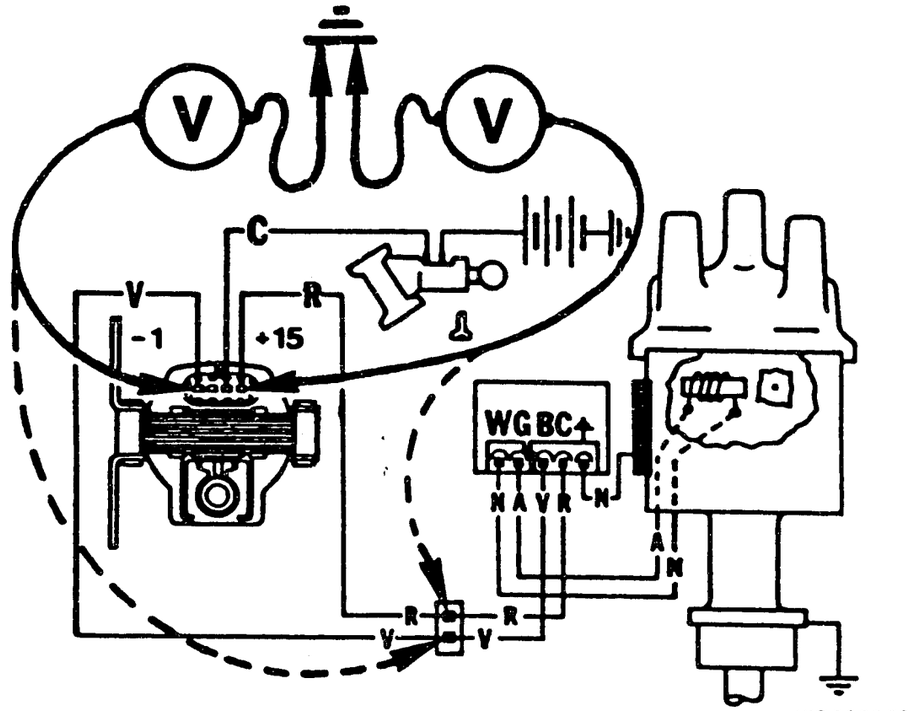


WS000049

Ignition-point markings Tipo 1400

The markings are located on the crankshaft pulley and on the toothed-belt cover (illustration).

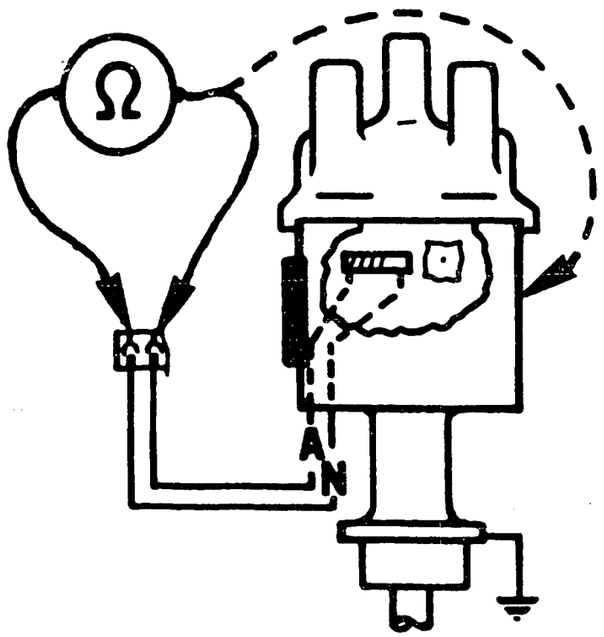
Ignition point at idle speed:
(800 ± 50 min $^{-1}$) = 10° before TDC.



WS000050

Checking the input voltage of the ignition coil and trigger box

c) The input voltage at the ignition coil and control unit must, with the ignition switched on, correspond to the battery voltage (illustration).



WS000051

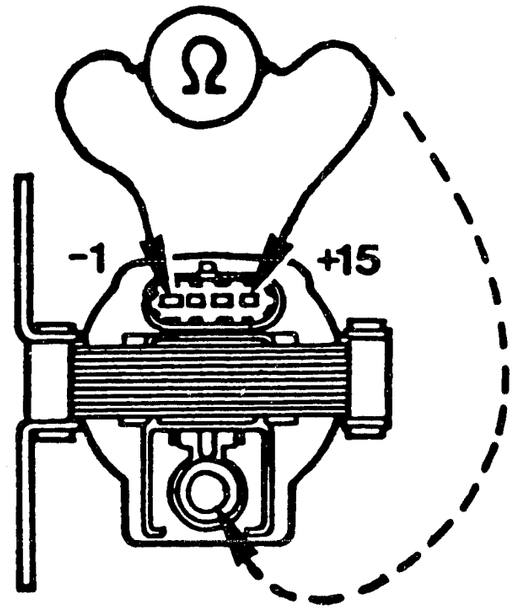
Resistance measurement at the pulse-generator coil and checking the pulse-generator coil for short circuit to ground.

d) For testing the resistance and testing for short circuit to ground of the pulse generator, disconnect the ignition distributor and the trigger box.

Important note:
Mark both plugs on the trigger box before removing them and be very careful when reconnecting them! Make sure that the ground terminal is not frayed, since contact with terminal C (it is not fused) results in a short circuit!

- Resistance of the terminals of the pulse-generator coil = 758 ... 872 Ω (illustration).

- Resistance of the terminals of the pulse-generator coil to housing ground = infinity Ω (illustration).



WS000052

Resistance measurement of primary winding and secondary winding.

e) The ignition-coil resistances must be measured with the plug disconnected. The resistance values apply at 20° C.

- Primary resistance = 0.666...0.814 Ω (illustration)

- Secondary resistance = 2.97 ...3.63 k Ω (illustration).

4. Work instructions

Tipo 1100:

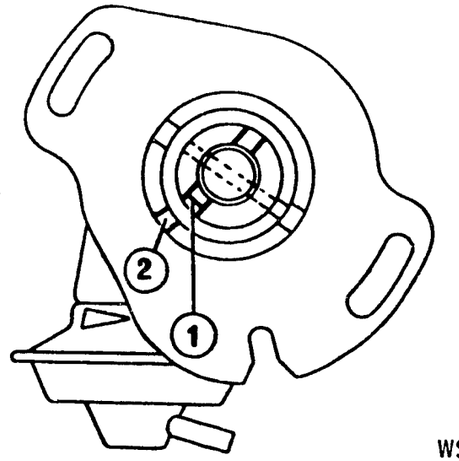
When installing the ignition distributor, the marking on the driver must align with the marking on the distributor housing (illustration).

Tipo 1400:

When installing the ignition distributor, the crankshaft V-belt pulley must be aligned to 0° (TDC) and the distributor rotor aligned with the marking on the dust-protection cover.

N o t e :

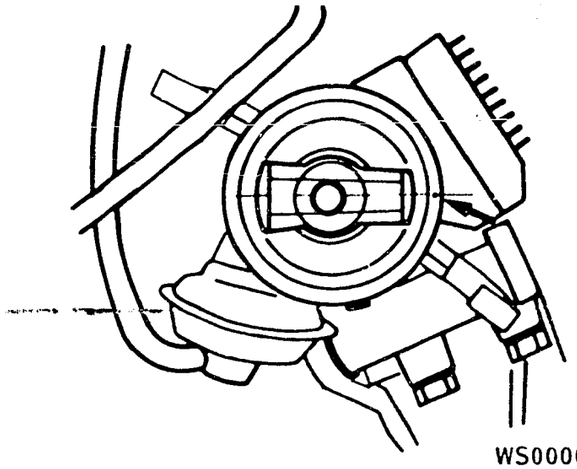
When the marking on the camshaft driving gear is in alignment with the marking on the cover, cylinder 4 is in the power stroke! The crankshaft must then be turned by 360° or the ignition-distributor shaft by 180°!

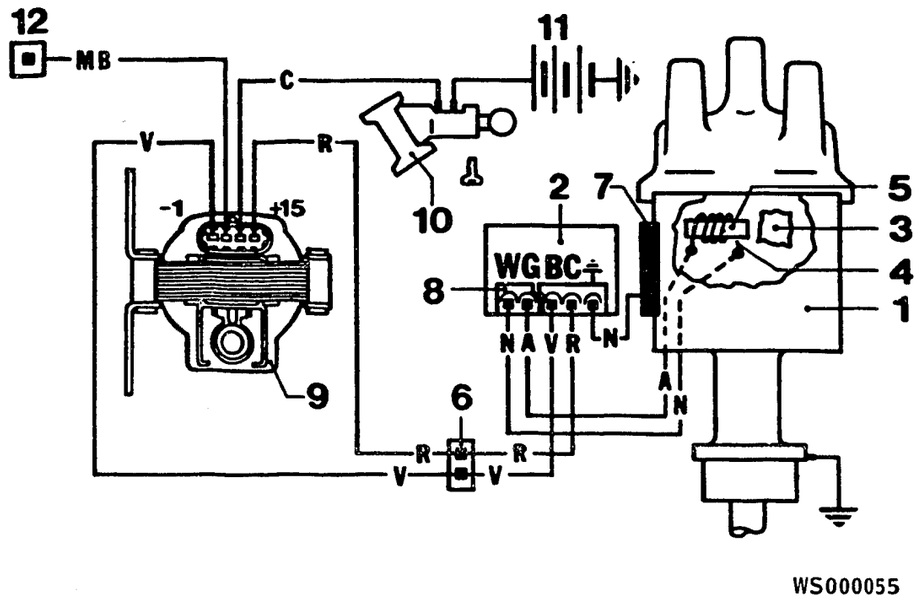


WS000053

Tipo 1100: Installation markings on ignition distributor:
1 = On the driver
2 = On distributor housing

Tipo 1400: Markings for ignition-distributor installation:
1 = Crankshaft at TDC
2 = Ignition at cylinder 4
3 = Center of rotor on marking

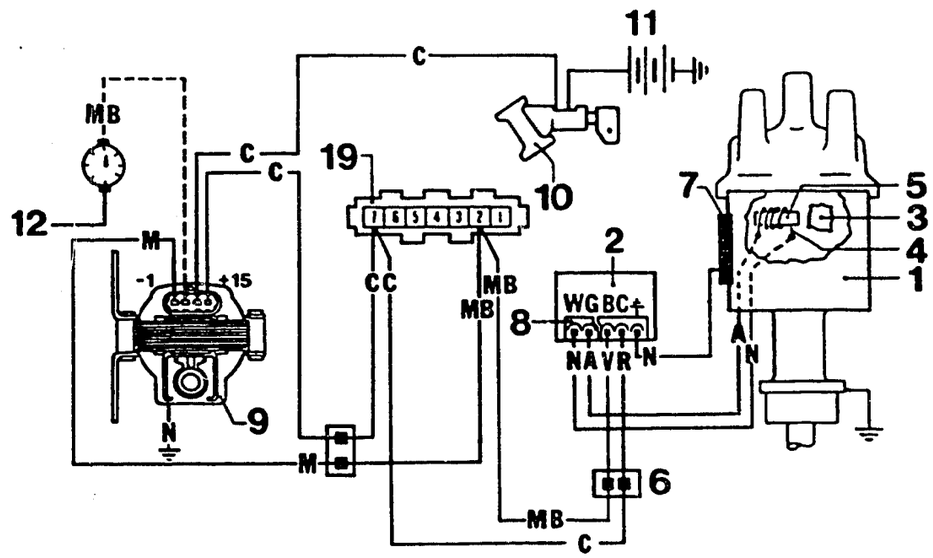

WS000054



WS000055

5. Electrical terminal diagram (Tipo 1100)

1 = Ignition distributor
2 = Control electronics
3 = Four-pin rotor
4 = Pulse-generator winding
5 = Stator
6 = Connecting plug,
control electronics - ignition coil
7 = Spacer
8 = Connecting plug, control electronics -
ignition distributor
9 = Ignition coil
10 = Starting switch
11 = Battery
12 = Electronic rev counter



WS000056

5. Electrical terminal diagram (Tipo 1400)

1 = Ignition distributor
2 = Control electronics
3 = Four-pin rotor
4 = Pulse-generator winding
5 = Stator
6 = Connecting plug, control electronics -
ignition coil - overrun cut-off
7 = Spacer
8 = Connecting plug, control electronics -
ignition distributor - ignition coil
9 = Ignition coil
10 = Starting switch
11 = Battery
12 = Electronic rev counter
19 = Control electronics of the overrun cut-off

7. Technical Data (Type 1100)

Engine	Type	1100 cc
	Power	41 kW/5500 min $^{-1}$
Ignition system	Make	Magneti Marelli
	Type	TCI with inductive-type pulse generator
Firing order		1-3-4-2
Cylinder 1		timing-housing end
Spark plugs		Bosch FR 7DC
	Electrode gap	0.7...0.8 mm
Ignition coil	Primary resistance	0.666...0.814 Ω
	Secondary resistance	2.97...3.63 k Ω
	Distributor-rotor resistance	approx. 5 k Ω
Ignition distributor	Pulse-generator resistance	758...872 Ω
Ignition point at idle speed (vacuum hose disconnected)		3° before TDC
(vacuum hose connected)		16° ± 2° before TDC
Idle speed		800...825 min $^{-1}$

8. Technical Data (Type 1400)

Engine	Type	1400 cc
	Power	51-52kW/6000 min $^{-1}$
Ignition system	Make	Magneti Marelli
	Type	TCI with inductive-type pulse generator
Firing order		1-3-4-2
Cylinder 1		timing-housing end
Spark plugs		Bosch WR 7DC for 1.41 and 1.41 Cat.
	Electrode gap	0.7...0.8 mm
Ignition coil	Primary resistance	0.666...0.814 Ω
	Secondary resistance	2.97...3.63 k Ω
	Distributor-rotor resistance	approx. 5 k Ω
Ignition distributor	Pulse-generator resistance	758...872 Ω
Ignition point at idle speed (vacuum hose disconnected)		10° before TDC ± 2° Cat.= 4° before TDC ± 2°
(Vacuum hose connected)		16° ± 2° before TDC
Idle speed		825...850/min.

This microcard was prepared exclusively for Bosch Service on behalf of ROBERT BOSCH GMBH STUTTGART

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto-Technik" magazine published by the AT-Fachschriftenverlag AG, CH-5001 Aarau.

The BOSCH equipment and the test specifications/ settings for BOSCH products and components are always to be taken from the BOSCH microcards. Test specifications and circuit diagrams are contained in the microcards and workshop documentation already introduced into BOSCH after-sales-service workshops.

For production reasons:
continued on the following coordinate.

1. Construction and Operation

The Digiplex 2 is a fully electronic ignition system whose electronic control unit determines the respective ignition point in accordance with a characteristic map on the basis of various input signals.

The main variables are the engine speed, crankshaft position and intake-manifold vacuum.

The pressure sensor is integrated in the control unit. TDC position and engine speed are picked up by a sensor that generates signals by means of five pins on the flywheel.

The same electronic unit controls also the overrun cut-off by cutting off the fuel supply via the idle cutoff valve when engine speeds are above 1700 min^{-1} and the throttle valve is closed.

Safety instructions

- Do not start the engine when the battery terminals are not mounted securely.
- Do not start the engine using a boost battery charger.
- Do not disconnect the battery when the engine is running.
- Disconnect the battery from the vehicle electrical system when boost charging.
- Remove the control unit at temperatures exceeding 80° C (stove-enamelling in drying oven).
- Disconnect the battery before carrying out electrical welding work.
- Do not disconnect or connect the plug of the control unit when the ignition is switched on!

2. Test equipment

The Digiplex can be tested using a voltmeter, ohmmeter, timing strobe, rev counter and vacuum gauge if the specific FIAT-Lancia tester is not available.

3. Trouble-shooting chart

Starting motor operates, engine fails to start	Engine runs on three cylinders	Engine sputters, poor performance, high fuel consumption	Cause	Remedy
	X		Spark plug	Replace spark plug
	X		Ignition cable between distributor and plug	Replace ignition cable
X			Ignition cable between distributor and ignition coil	Replace main ignition cable
	X		Distributor cap cracked	Replace distributor cap
X			Distributor rotor defective	Replace rotor
X			Ignition coil: – Open circuit – Short circuit – Short circuit to ground	Replace ignition coil
X			TDC/engine-speed sensor:	
X			– Air gap too wide	Adjust air gap
X			– Short circuit, open circuit	Replace sensor
X			– No ground, no current	Check connecting cable
		X	– Sensor set incorrectly	Set sensor
		X	Vacuum hose leaking	Replace vacuum hose
		X	Incorrect ignition advance	Replace control unit
X			Control unit defective	Replace control unit
		X	Compression too low	Repair engine
X			No compression	Repair valves/engine
	X		Valve burnt	Repair cylinder head
X			Tank ventilation closed	Clean ventilation lines
X			Water in fuel	Clean tank, carburetor, fuel lines
X			Intake manifold leaking	Face sealing surfaces
X		X	Fuel pump defective	Replace fuel pump

4. Testing the individual components

a) The ignition point at idle speed and the ignition advance must be determined using a timing strobe, vacuum gauge and rev counter and must then be compared with the set values. The markings are located on the crankshaft pulley and on the toothed-belt cover (see upper illustration).

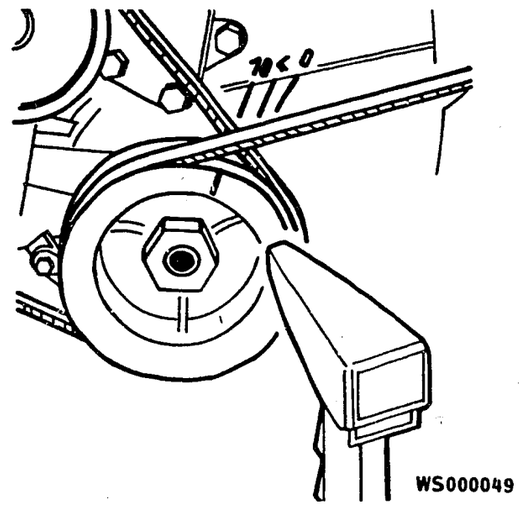
- If the ignition advance is not correct, check the vacuum hose or replace the control unit.

- Ignition point at idle speed (800...850 min $^{-1}$) = 12° ± 2° before TDC
  (Cat. 850 min $^{-1}$) = 10° ± 2° before TDC

b) Measure resistance of the TDC and engine-speed sensor between terminals 7 and 8 at the disconnected plug of the control unit:

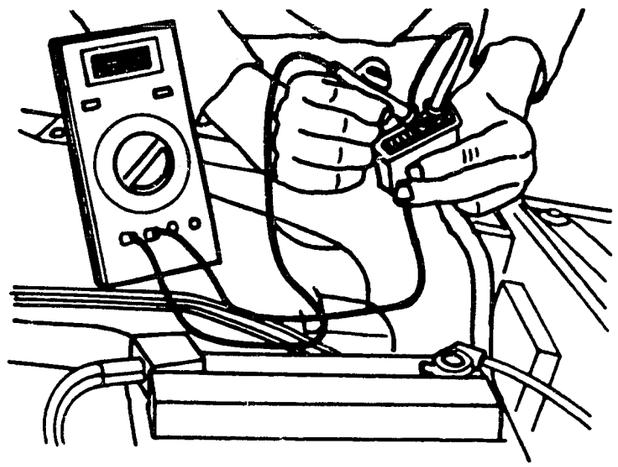
Set value = 680 ... 920 Ω (lower illustration)

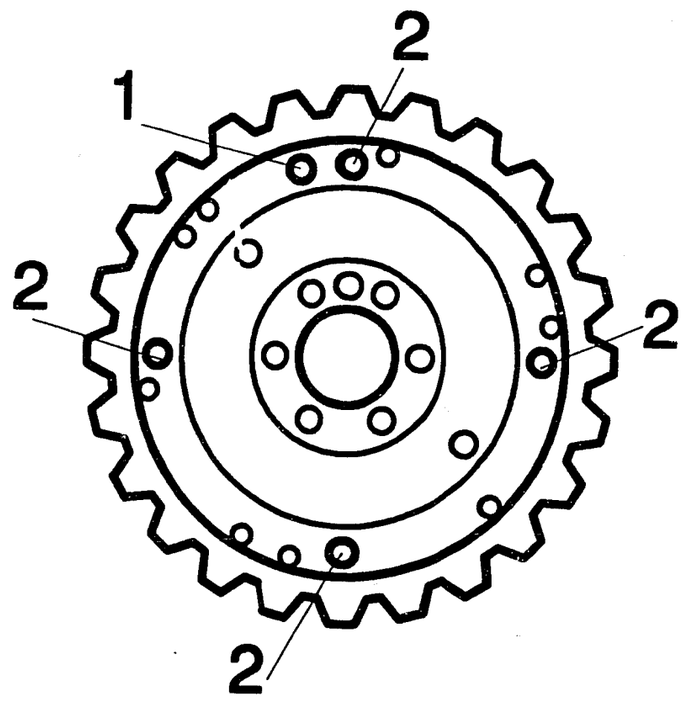
- If the set value is not obtained, check the plug-in connection to the sensor and replace the sensor if necessary.



Markings for TDC and ignition advance on the crankshaft V-belt pulley and toothed-belt cover.

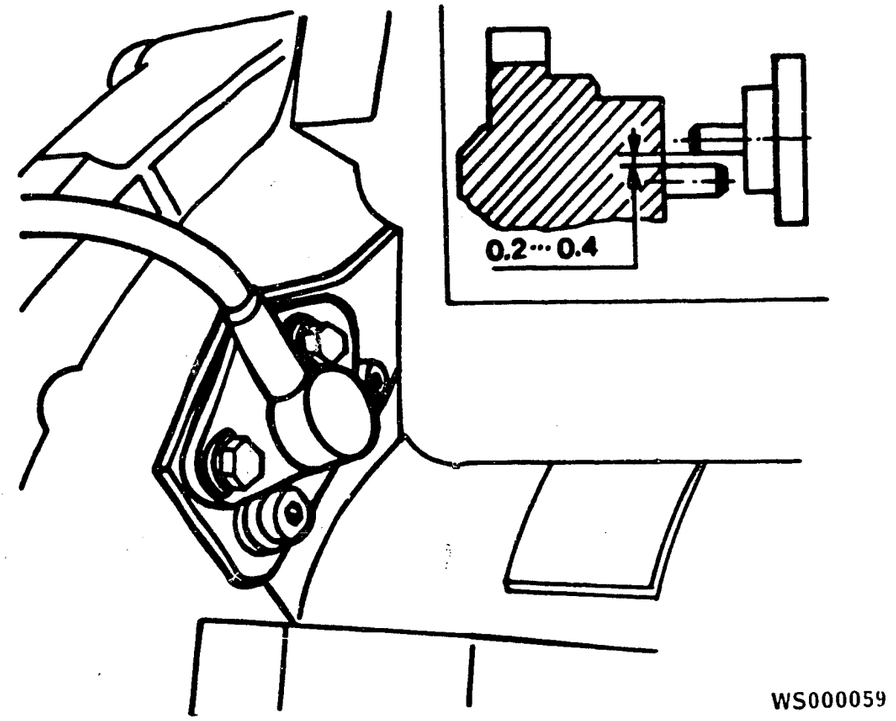
Resistance measurement of the TDC and engine-speed sensor at the plug of the control unit.





WS000058

Pins for TDC measurement (1) and engine-speed measurement (2) on the flywheel.



WS000059

Air gap - sensor/flywheel

c) The air gap between the TDC/engine-speed sensor and the flywheel pins must be 0.2...0.4 mm (illustration).

The sensor plate on the flywheel can be tested and adjusted using a special tool.

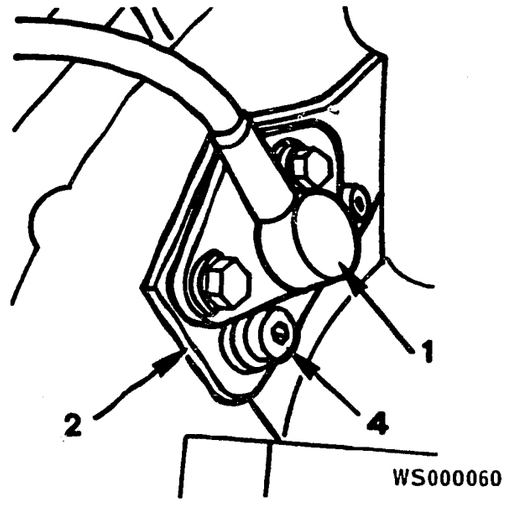
For this purpose, position the crankshaft to TDC for cylinder 1 (coordinate 06) and unscrew the sensor from the base plate.

One of the two screws of the base plate is a shear-head screw.

Loosen the TDC and engine-speed sensor (1) and insert the special tool (2) for checking the basic setting.

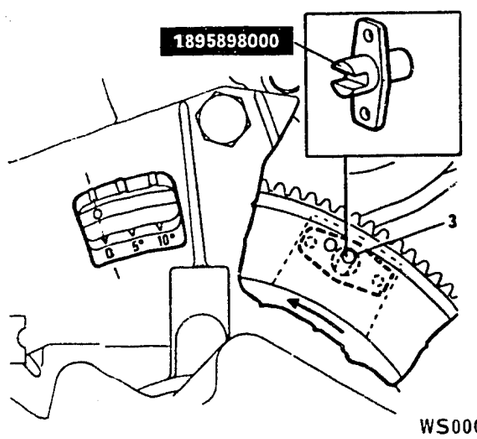
Set the base plate by loosening the screws (4) (upper illustration).

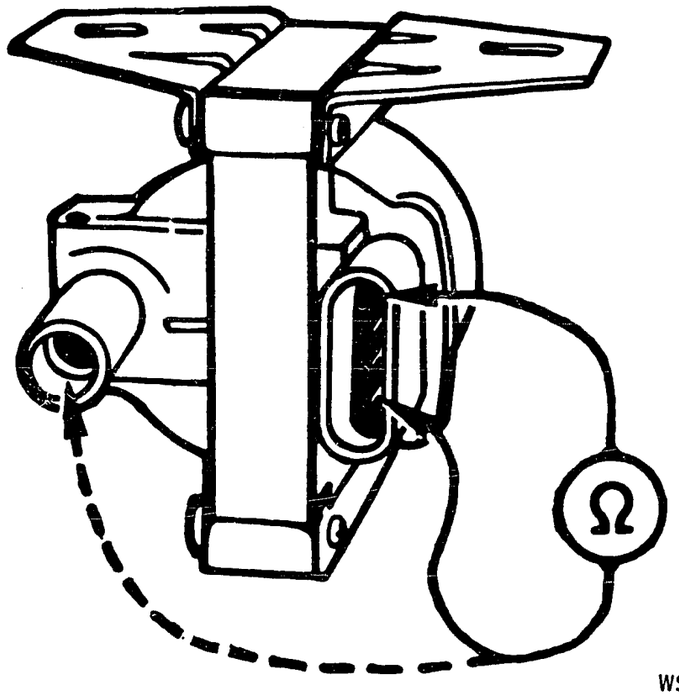
There must be no problem in inserting the special tool (1 895 898 000) into the bore of the sensor and in locating the pin (3) on the flywheel (lower illustration).



1 = TDC and engine-speed sensor
2 = Special tool
4 = Screws

Special tool 1 895 898 000
3 = Pin





WS000062

Resistance measurement at the ignition coil

d) Test the resistance of the ignition coil.

The values apply at 20° C:

- Primary resistance = 0.405...0.495 Ω
- Secondary resistance = 4.32 ...5.28 k Ω (illustration)

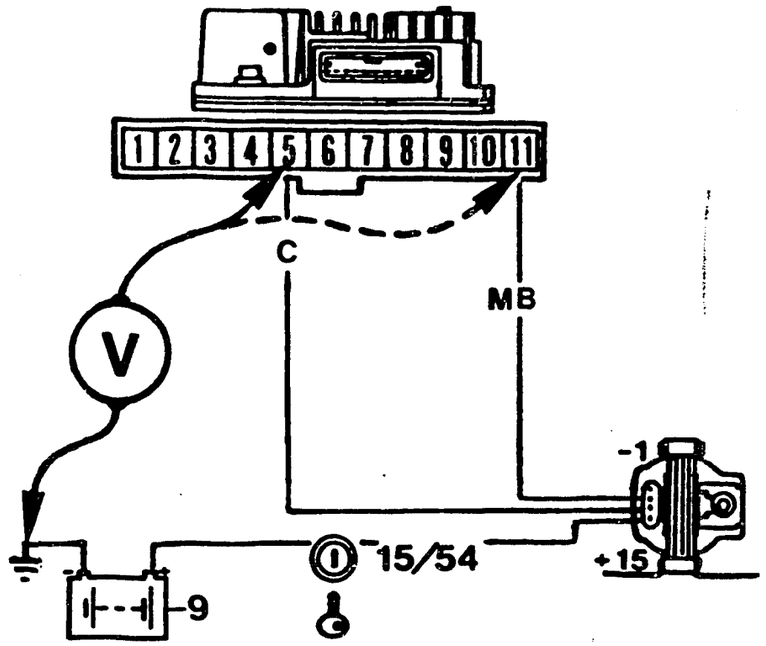
e) Check the power supplies and ground terminal on the control unit itself.

An operational check of the TDC and engine-speed sensor is made on starting via terminal 3.

If there is a fault, it is stored in the control unit.

The connection does not influence operation of the ignition system!

Before disconnecting the plug, always switch off the ignition!



WS000063

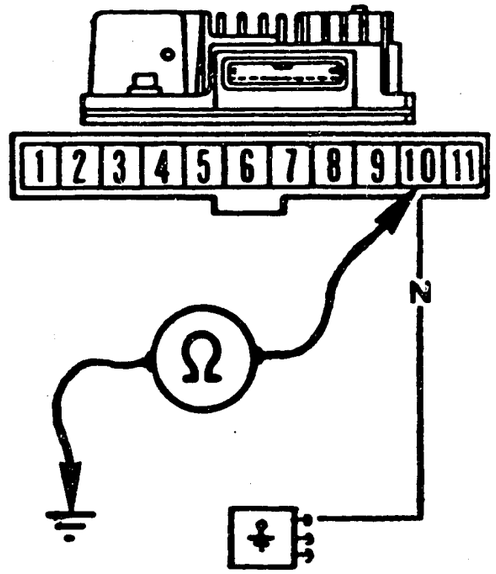
Test the power supply of the control unit

- Battery voltage must be measured between term. 5 and ground (illustration) when the ignition is switched on.

  If battery voltage is not picked up, check cables for open circuit.

- Battery voltage must be measured between term. 11 and ground (illustration) when the ignition is switched on.

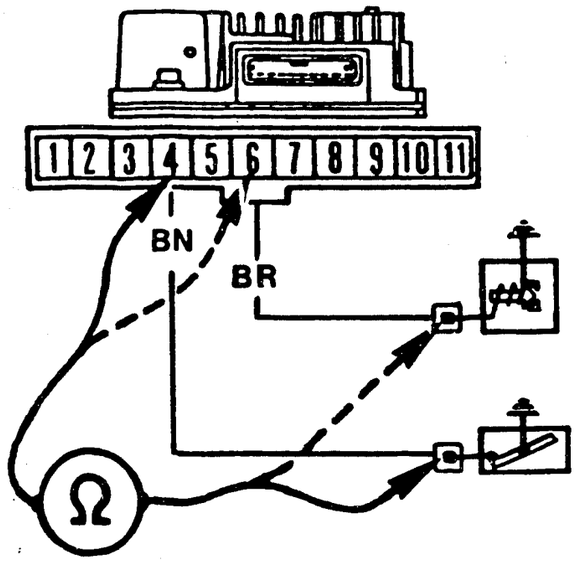
  If battery voltage is not picked up, check the primary winding of the ignition coil and the cable to term. 11.



WS000064

Test control unit for short circuit to ground

- There must be continuity of power supply between term. 10 and ground (illustration) when the ignition is switched off.



WS000065

Test the connections between the control unit and idle cutoff valve (dashed lead) and the control unit and throttle-valve switch (disconnected) for continuity (illustration).

f) With regard to the overrun cut-off, test the two connections from the throttle-valve switch and to the idle cutoff valve for continuity, starting from the control-unit plug:

- Terminal 6 to idle cutoff valve

- Terminal 4 to throttle-valve switch

  When the throttle valve is opened by 2°, the connection must be open-circuited:

  Resistance: infinitiy Ω

For production reasons: continued on the following coordinate.

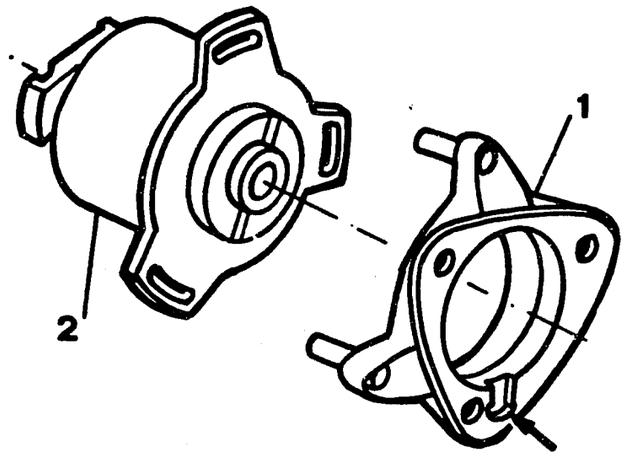
5. Work instructions

When installing the ignition distributor, the recess (arrow, upper illustration) of the intermediate flange must point downward.

The adjustment slots are provided for adjusting the rotor position and not for adjusting the ignition point!

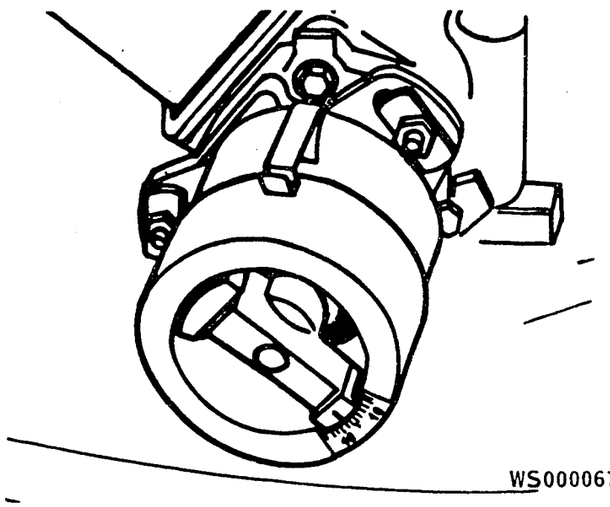
Correct adjustment is made using a special tool while cylinder 4 is at TDC of the compression stroke (lower illustration).

There is a special tool (1) for adjusting the rotor (2) precisely, the tool being clamped on in place of the distributor cover.

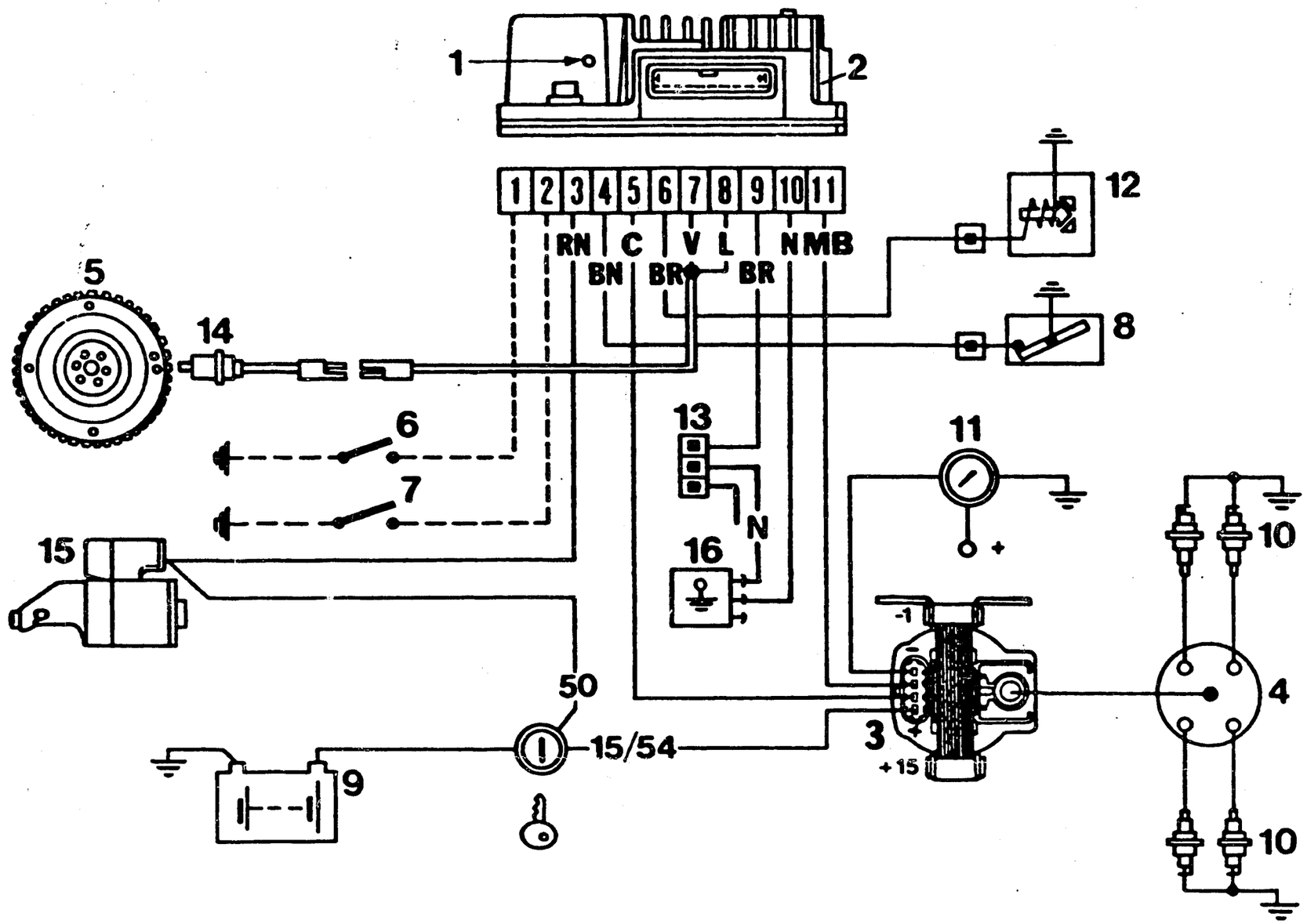


WS000066

1 = Spacer
2 = Ignition distributor



WS000067



WS000068

6. Electrical terminal diagram

1 = Vacuum connection
2 = Control unit
3 = Ignition coil
4 = Ignition distributor
5 = Flywheel
6 = Switch for ignition timing
7 = Switch for ignition-point adjustment
8 = Throttle-valve switch
9 = Battery
10 = Spark plugs
11 = Rev counter
12 = Connection to overrun-cutoff valve
13 = Diagnostic plug
14 = TDC and rev counter
15 = Starting motor
16 = Ground terminal

7. Technical Data

Engine	Type	1600 cc
	Power	60 kW/6000 min $^{-1}$ Cat. 66 kW/6250 min $^{-1}$
Ignition system	Make	Magneti Marelli
	Type	Digiplex 2
Firing order		1–3–4–2
Cylinder 1		timing–housing end
Spark plugs	Make/Type	Bosch WR 6DC Cat. converter: Bosch WR 7DC
	Electrode gap	0.6...0.7 mm Cat. converter: 0.7...0.8 mm
Ignition coil	Make	Magneti Marelli
	Type	BAE 504 D
	Primary resistance	0.405...0.495 Ω
	Secondary resistance	4.32... 5.28 k Ω

Technical Data (Continued)

Ignition distributor	Make	Magneti Marelli
	Type	DT 402 BX
Ignition point	at idle speed	12° ± 2° before TDC without vacuum hose Cat. converter: 10° ± 2° before TDC with vacuum hose
Idle speed		825 ± 25 min $^{-1}$ Cat. = 850 min $^{-1}$ *)
Control unit	Make	Magneti Marelli
	Type	MED 433A
TDC/engine–speed sensor	Resistance	680...920 Ω
	Air gap	0.2...0.8 mm

*) electronically controlled.

This microcard was prepared exclusively for Bosch Service on behalf of ROBERT BOSCH GMBH STUTTGART

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto-Technik" magazine published by the AT-Fachschriftenverlag AG, CH-5001 Aarau.

The BOSCH equipment and the test specifications/ settings for BOSCH products and components are always to be taken from the BOSCH microcards. Test specifications and circuit diagrams are contained in the microcards and workshop documentation already introduced into BOSCH after-sales-service workshops.

For production reasons: continued on the following coordinate.

LANCIA THEMA 2000 ie
FIAT Croma 2000 ie 88 kW (Cat. 85 kW)

1. Construction and Operation

The Digiplex is a fully electronic ignition system in which the electronic control unit determines the respective ignition point in accordance with a characteristic map on the basis of various input signals. The main variables are the engine speed, crank shaft position and the vacuum in the intake manifold.

The pressure sensor is integrated in the control unit that is installed in the engine compartment at the front left. The engine speed is picked up by a sensor on the flywheel and the TDC position by a sensor on the crankshaft pulley.

Safety instructions

- Do not start the engine if the battery terminals are not secured tightly.
- Do not start the engine using a boost battery charger.
- Do not disconnect the battery when the engine is running.
- Disconnect the battery from the vehicle electrical system when boost charging.
- Remove the control unit if temperatures will exceed 80° C (stove-enamelling in drying oven).
- Disconnect the battery before carrying out electrical welding work.
- Do not disconnect or connect the plug of the control unit when the ignition is switched on!

2. Test equipment

The Digiplex can be tested using a voltmeter, ohmmeter, timing strobe, rev counter and vacuum gauge if the specific FIAT-Lancia tester is not available.

3. Trouble-shooting chart

Starting motor operates, engine fails to start
Engine not running smoothly, misfiring cylinders
Engine sputtering, poor performance, high fuel consumption

			Cause	Remedy
	X		Spark plug	Replace plug
	X		Ignition cable between distributor and plug	Replace ignition cable
X			Ignition cable between distributor and ignition coil	Replace main ignition cable
	X		Distributor cap cracked	Replace distributor cap
X			Distributor rotor defective	Replace rotor
X			Ignition coil	Replace ignition coil
X		X	TDC/engine-speed sensor:	Check resistance Test cables, connections Check air gap
		X	Vacuum hose leaking	Replace vacuum hose
		X	Incorrect ignition advance	Replace control unit Check flywheel ring gear
X			Control unit defective	Replace control unit
		X	Compression too low	Repair engine
X			No compression	Repair valve/engine
	X		Valve burnt	Repair cylinder head
X			Tank ventilation closed	Clean ventilation lines
X			Water in fuel	Clean tank, carburetor, fuel lines
X		X	Fuel pump defective	Replace fuel pump
		X	Fuel-injection system faulty	Check fuel-injection system
	X	X	Intake manifold leaking	Face sealing surfaces

4. Testing the individual components

a) Determine the ignition point at idle speed and the ignition advance using a timing strobe, vacuum gauge and rev counter and compare with the set values.
The markings are located on the crankshaft pulley and toothed-belt cover (see upper illustration).

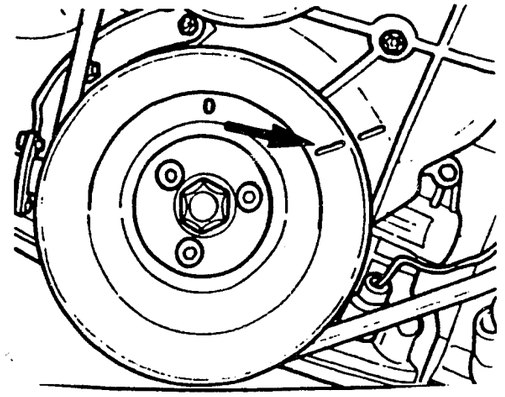
- Set values: at idle = 8° ± 2° before TDC
  maximum = 38° ± 2° before TDC

Note:
The entire ignition map can be retarded in three stages up to 5° 30′ by means of terminals 6 and 7 at the control-unit output. Both terminals are shown as open in the illustration; i.e. no retardation of the map!

b) Measure resistance of the engine-speed sensor between terminals 2 and 3 at the disconnected plug of the control unit (see lower illustration).

- Set value: = 618 ... 748 Ω

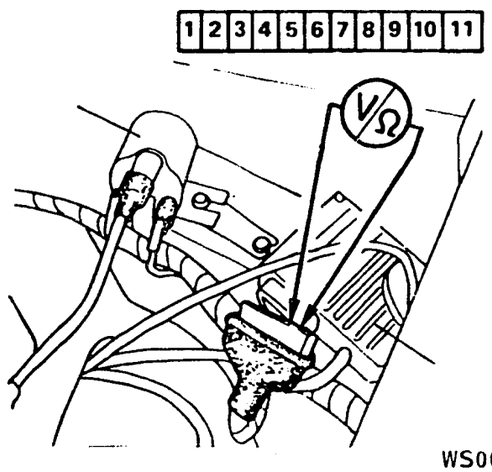
- If the set value is not obtained, check the plug-in connection to the sensor and check the air gap; replace the sensor if necessary.



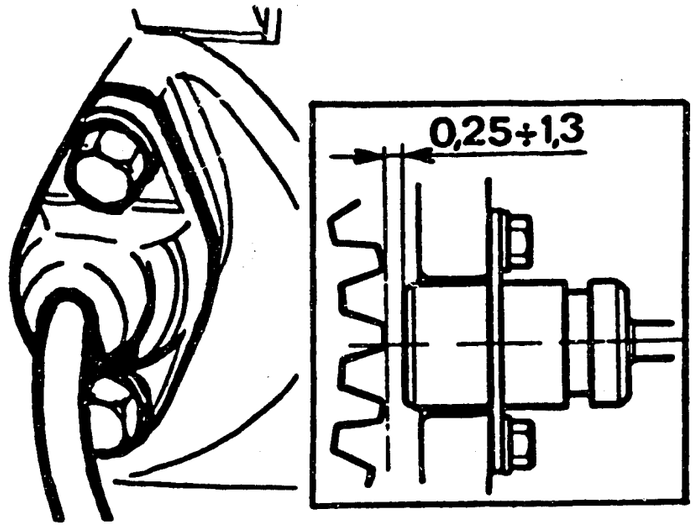
WS000069

Ignition-point marking on crankshaft pulley and toothed-belt cover

Voltage and resistance measurements at the disconnected control-unit plug



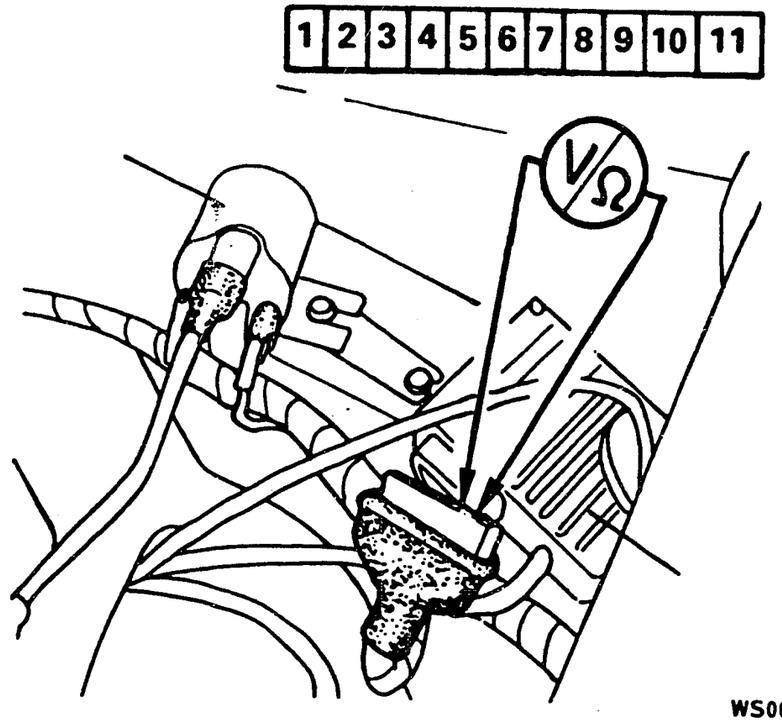
WS000070



WS000071

c) Check air gap between engine–speed sensor and flywheel (illustration).
Set value: 0.25 ... 1.3 mm.

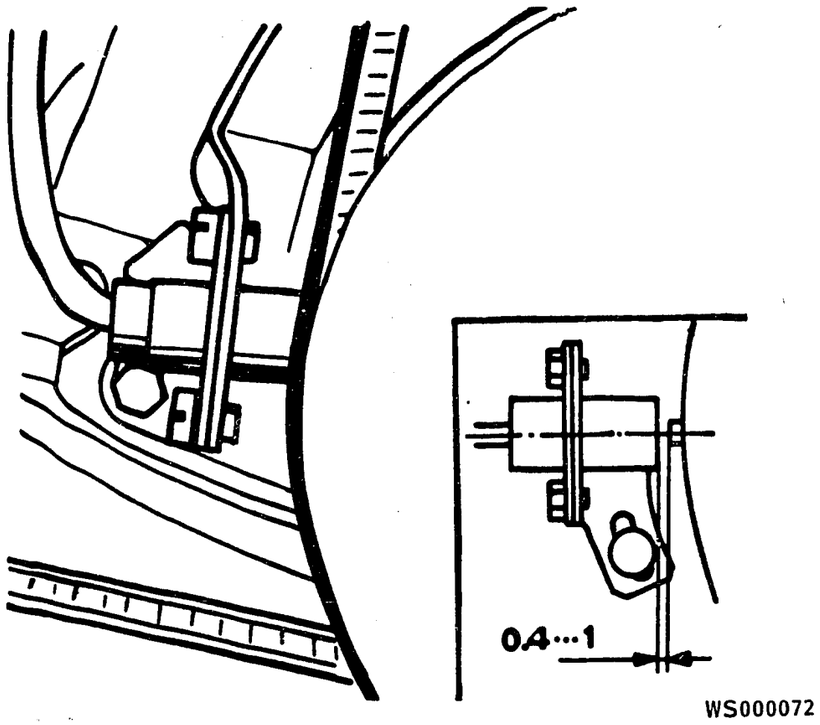
The sensor cannot be adjusted.
Check the ring gear on the flywheel for defects or worn teeth!



WS000070

d) Measure resistance of the TDC sensor between terminals 1 and 5 at the disconnected plug on the control unit (illustration).

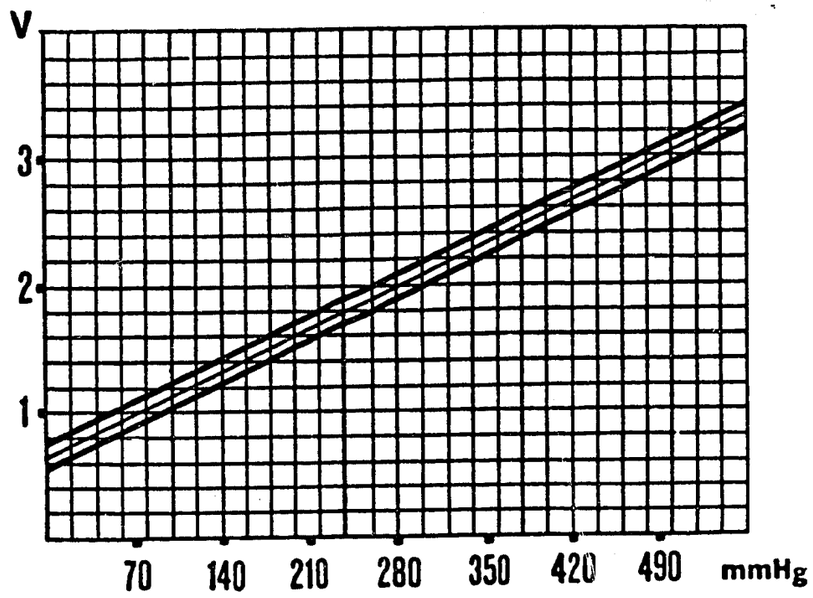
Set value: 618 ... 748 Ω



WS000072

e) Check air gap between the TDC sensor and crankshaft pulley (illustration).

Set value: 0.4 ... 1.0 mm



WS000073

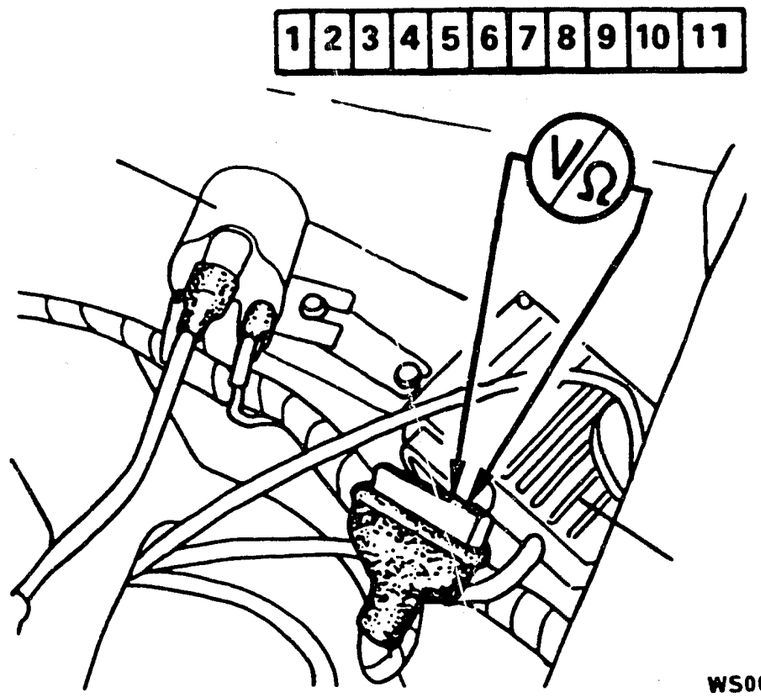
Chart: Voltage at terminal 4 of the control unit at specified intake-manifold vacuum.

f) The pulse of the intake-manifold pressure can be tested at the control-unit output, terminal 7, using a vacuum hand pump and voltmeter (illustration).

Tolerance: ± 0.12V

g) Test the resistance of the ignition coil.

- Primary resistance = 0.310...0.378 Ω /20° C
- Secondary resistance = 3.330...4.070 k Ω /20° C.



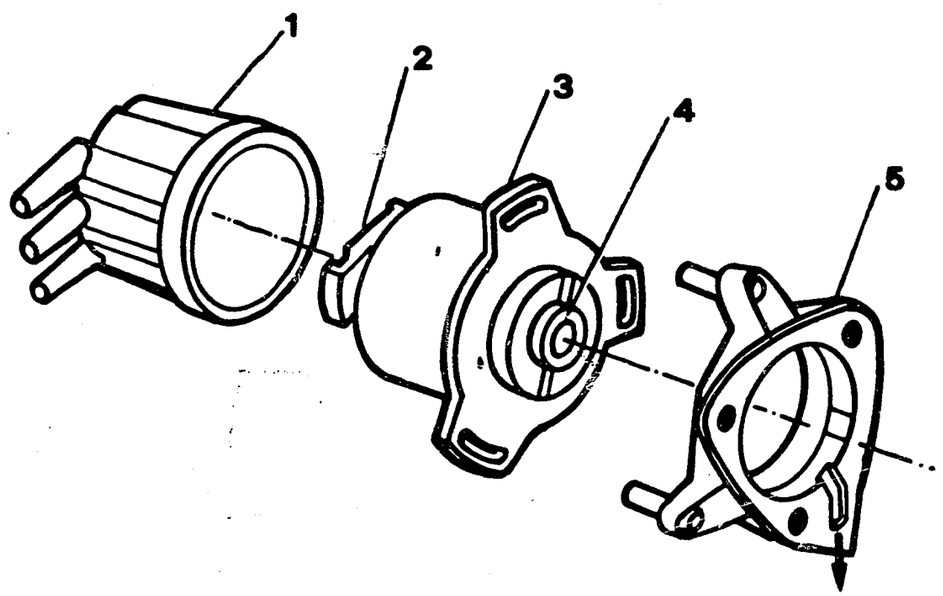
WS000070

Voltage and resistance measurements at the disconnected control-unit plug

h) Test the power supply and the ground terminal at the control unit itself (illustration).
Always switch off the ignition before disconnecting the plug!

- Power supply: battery voltage between terminals 9 and 11 when the ignition is switched on. If battery voltage is not measured, check cables for open circuit.

- Ground: battery voltage between terminals 8 and 9 when ignition switched on. If battery voltage is not measured, check cables for open circuit.



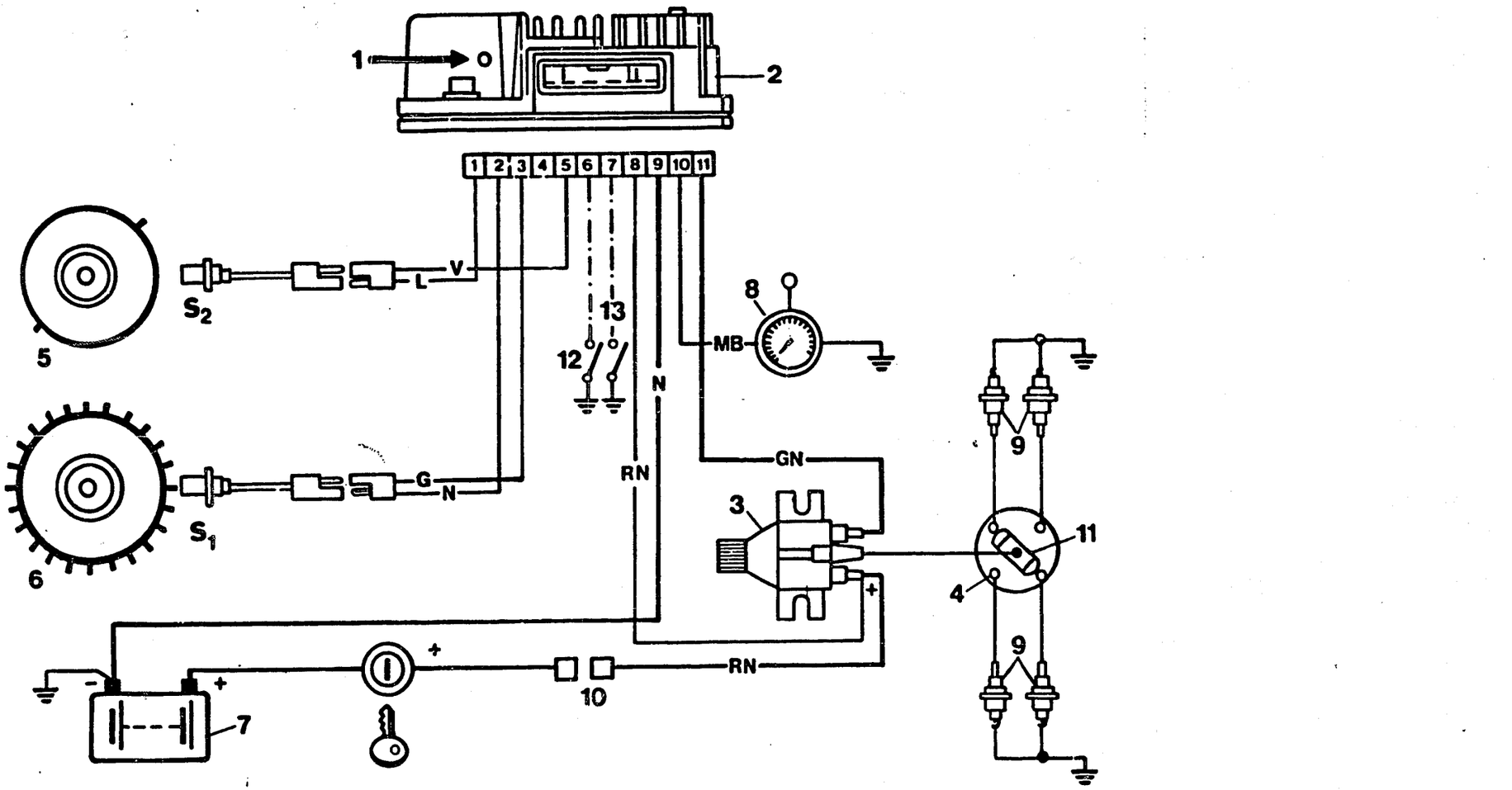
WS000074

1 = Distributor cover
2 = Rotor
3 = Distributor housing
4 = Driver
5 = Intermediate flange

4. Work instructions

a) When installing the ignition distributor, the recess of the intermediate flange must point downward (illustration). The adjustment slots are provided for adjusting the rotor position and not adjusting the ignition point!

b) The TDC sensor on the crankshaft pulley cannot be adjusted. Determine the precise TDC position for the sensor by moving the cylinder head and measuring the piston stroke!



WS000075

5. Electrical terminal diagram

1 = Vacuum connection
2 = Control unit
3 = Ignition coil
4 = Ignition distributor
5 = Crankshaft V-belt gear
6 = Flywheel
7 = Battery
8 = Engine-speed sensor
9 = Spark plugs
10 = Plug-in connection
11 = Rotor
12/13 = Circuit for retardation
– S1 Eng.-speed sensor – S2 TDC sensor

6. Technical Data

Engine	Type	2000 cc
	Power	88kW/5250 min $^{-1}$ Cat. 85kW/5600 min $^{-1}$
Ignition system	Make	Magneti Marelli
	Type	Digiplex
Firing order		1–3–4–2
Cylinder 1		near toothed-belt drive
Spark plugs	Make/Type	Bosch WR 6DC
	Electrode gap	0.6...0.7 mm
Ignition coil	Primary resistance	0.310...0.378 Ω
	Secondary resistance	3.330...4.070 k Ω
Ignition distributor	Make	Magneti Marelli
	Type	DT 402 BX
	Rotor resistance	0.8...1.2 k Ω
	Ignition-cable resistance	max. 25 k Ω

Ignition point	at idle	8° ± 2° before TDC
	maximum	38° ± 2° before TDC
Idle speed		800...900 min $^{-1}$ Cat. = 850 min $^{-1}$
Control unit	Make	Magneti Marelli
	Type	MED 409A
Engine-speed sensor	Type	Magneti Marelli SEN 8E
	Resistance	612... 748 Ω
	Air gap	0.25...1.3 mm
TDC sensor	Type	Magneti Marelli SEN 8D
	Resistance	612...748 Ω
	Air gap	0.4...1.0 mm

This microcard was prepared exclusively for Bosch Service on behalf of ROBERT BOSCH GMBH STUTTGART

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto-Technik" magazine published by the AT-Fachschriftenverlag AG, CH-5001 Aarau.

The BOSCH equipment and the test specifications/ settings for BOSCH products and components are always to be taken from the BOSCH microcards. Test specifications and circuit diagrams are contained in the microcards and workshop documentation already introduced into BOSCH after-sales-service workshops.

For production reasons: continued on the following coordinate.

LANCIA THEMA IE TURBO

1. Construction and Operation

The control unit in the fully electronic Microplex ignition system from Magneti Marelli assumes alongside determination of the ignition point (in accordance with a characteristic map), the control of the overboost (safety pressure switch).

This permits the charge-air pressure to be increased by 0.3 bar for a maximum of 30 s as of 2500 min^{-1} and a maximum of 2 s at 5300 min^{-1} when accelerating.

The control unit receives information from the engine-speed sensor on the flywheel, from the TDC sensor on the crankshaft pulley and from the pressure sensor in the intake manifold.

The knock sensor acts as a correcting variable.

The control unit that is mounted in the engine compartment near the battery determines the ignition point in accordance with a characteristic map.

The transistorized trigger box triggers the ignition coil. A safety switch on the intake manifold interrupts the ignition if the charge-air pressure exceeds 1.18 bar.

Safety instructions

- Do not start the engine unless the battery terminals are secured tightly.
- Do not start the engine using a boost battery charger.
- Do not disconnect the battery when the engine is running.
- Disconnect the battery from the vehicle electrical system when boost charging.
- Remove the control unit if temperatures will rise above 80° C (stove-enamelling in drying oven).
- Disconnect the battery before carrying out electrical welding work.
- Do not disconnect or connect the plug of the control unit when the ignition is switched on!

2. Test equipment

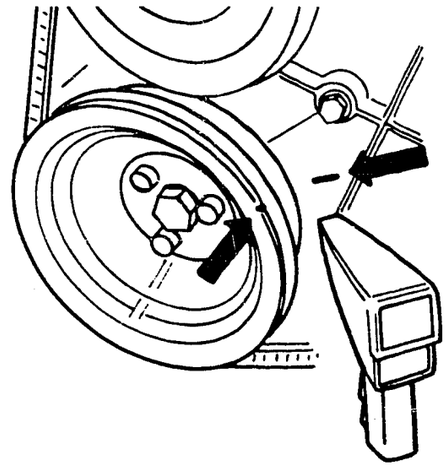
The Microplex can be tested using a voltmeter, ohmmeter, timing strobe, rev counter and vacuum gauge if the specific FIAT-Lancia tester is not available.

3. Testing the individual components

a) The ignition point at idle speed and at various engine speeds or loads can be checked on the basis of the markings on the crankshaft pulley and toothed-belt cover (upper illustration), and with the aid of the ignition-timing charts.

Set value: ignition point at idle 10° before TDC (Cat. = 15°)

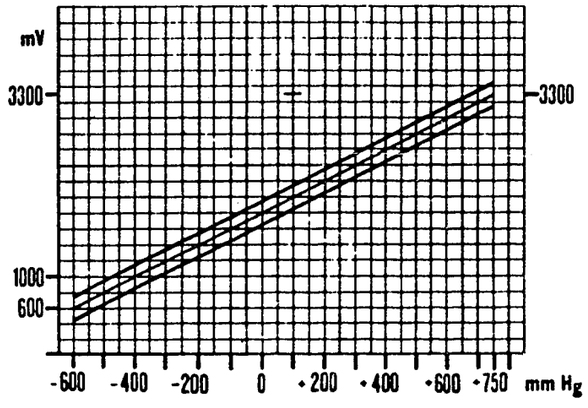
If the ignition advance is not correct, check the pressure hose and vacuum hose between the intake manifold and control unit, and the pressure converter in the control unit with the aid of the chart (lower illustration).



WS000076

Ignition-point check using timing strobe at the crankshaft gear

Voltage curve at the control unit (terminal 23) under various pressure ratios in the intake manifold



WS000077

b) Test the engine-speed sensor between terms. 3 and 16 at the disconnected plug of the control unit (see illustration).

Set value: 618...748 Ω at 20° C

If the set value is not obtained, measure resistance at the connecting plug to the sensor; replace the sensor if necessary.

c) Test TDC sensor between terms. 1 and 2 at the disconnected plug of the control unit (see illustration).

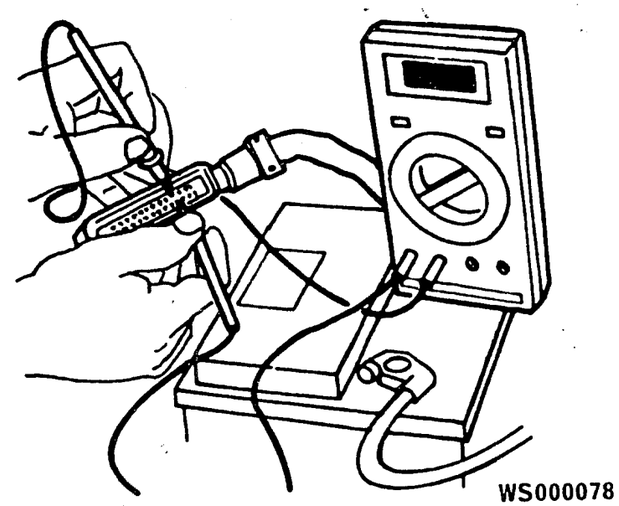
Set value: 618 ... 748 Ω at 20° C

If set value is not obtained, measure resistance at the connecting plug to the sensor; replace sensor if necessary.

d) Power supply of control unit can be tested between term. 13 (B+) and 11 (ground) at disconnected plug using a voltmeter and with ignition switched on (see ill.).

Set value: battery voltage

If battery voltage is not obtained, check plug-in connections, cables and ground terminal.



Resistance measurement and voltage measurement at the control-unit plug

e) Test the power supply of the trigger box and ignition coil step-by-step (upper illustration):

1. Voltmeter at terminal 4 and ground, ignition switched on:
   Set value = battery voltage

   – If battery voltage not obtained, continue with point 2.
   – If battery voltage is obtained, continue with point 3.

2. Connect voltmeter to ignition coil (terminal 15) and ground:
   Set value = battery voltage

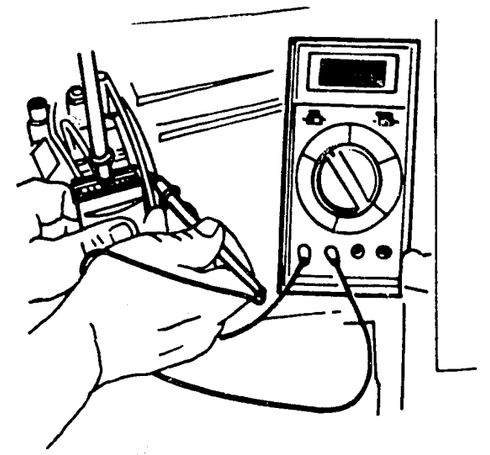
   – If battery voltage is not obtained, check plug-in connections and leads to the ignition coil and battery.

3. Connect voltmeter between terminals 4 and 2:
   Set value: battery voltage

   – If battery voltage is not obtained, check plug-in connections and leads to control unit (terminal 12), test for continuity to terminal 11 at the control unit, and check connection to ground.

f) Test the ignition coil for primary resistance and secondary resistance.

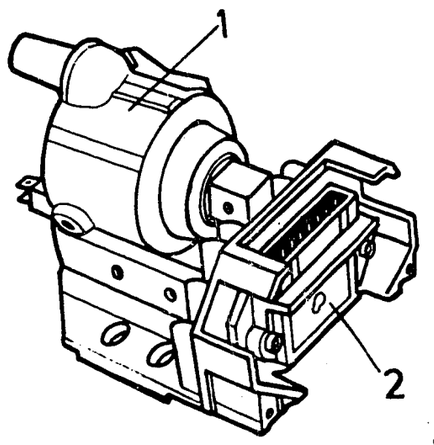
   Set value: Primary resistance = 0.405...0.495 Ω
   Secondary resistance = 4320 ... 5280 k Ω



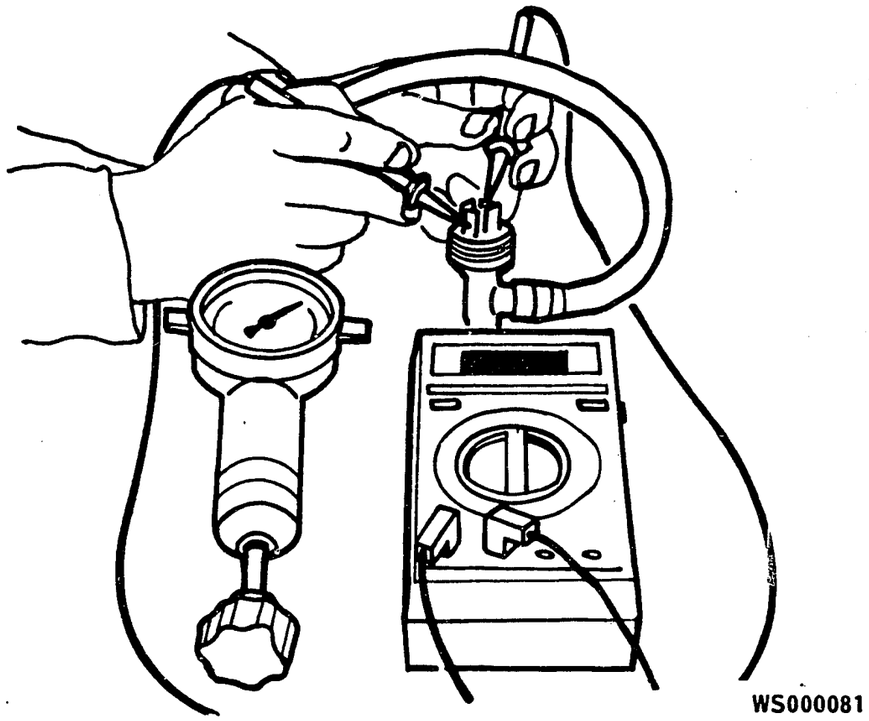
WS000079

Voltage measurements at the trigger-box plug

1 = Ignition coil
2 = Ignition trigger box



WS000080



WS000081

Test safety pressure switch.

g) The safety pressure switch must be removed for being tested.

   With an ohmmeter connected, build up pressure slowly with a pressure pump (upper illustration)

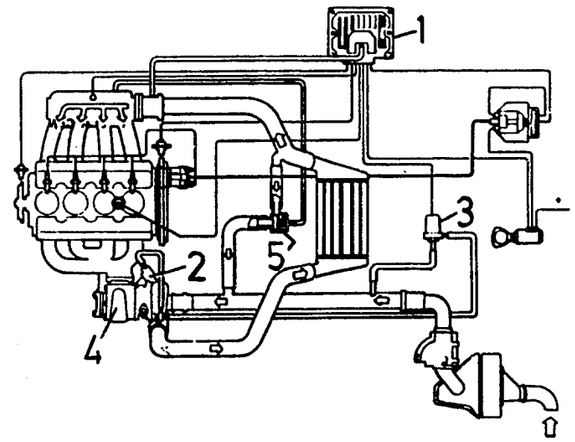
   If the switch does not close at 1.18 bar, replace it.

h) The control unit and trigger box may be replaced only after the entire periphery has been tested. Only the trigger box should be replaced first of all.

1) To test operation of the solenoid valve of the overboost (see upper and lower illustrations), connect it, with the plug disconnected, to 12 V and connect it to ground.
If the valve is intact, it can be heard clearly as it opens and shuts.

Schematic overview of the overboost

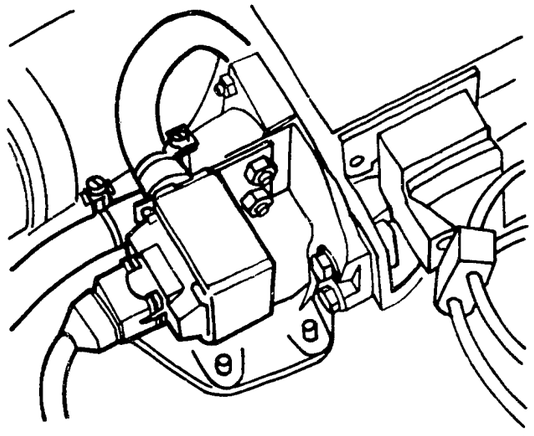
The Microplex control unit opens the solenoid valve in order to reduce the pressure at the wastegate.
The wastegate closes and the charge-air pressure increases.
The exhaust turbo-supercharger and the bypass valve protect the super-charger against violent increase in temperature.



WS000082

1 = Microplex control unit
2 = Wastegate
3 = Solenoid valve
4 = Exhaust-turbo supercharger
5 = Bypass valve

Position of the solenoid valve for the overboost

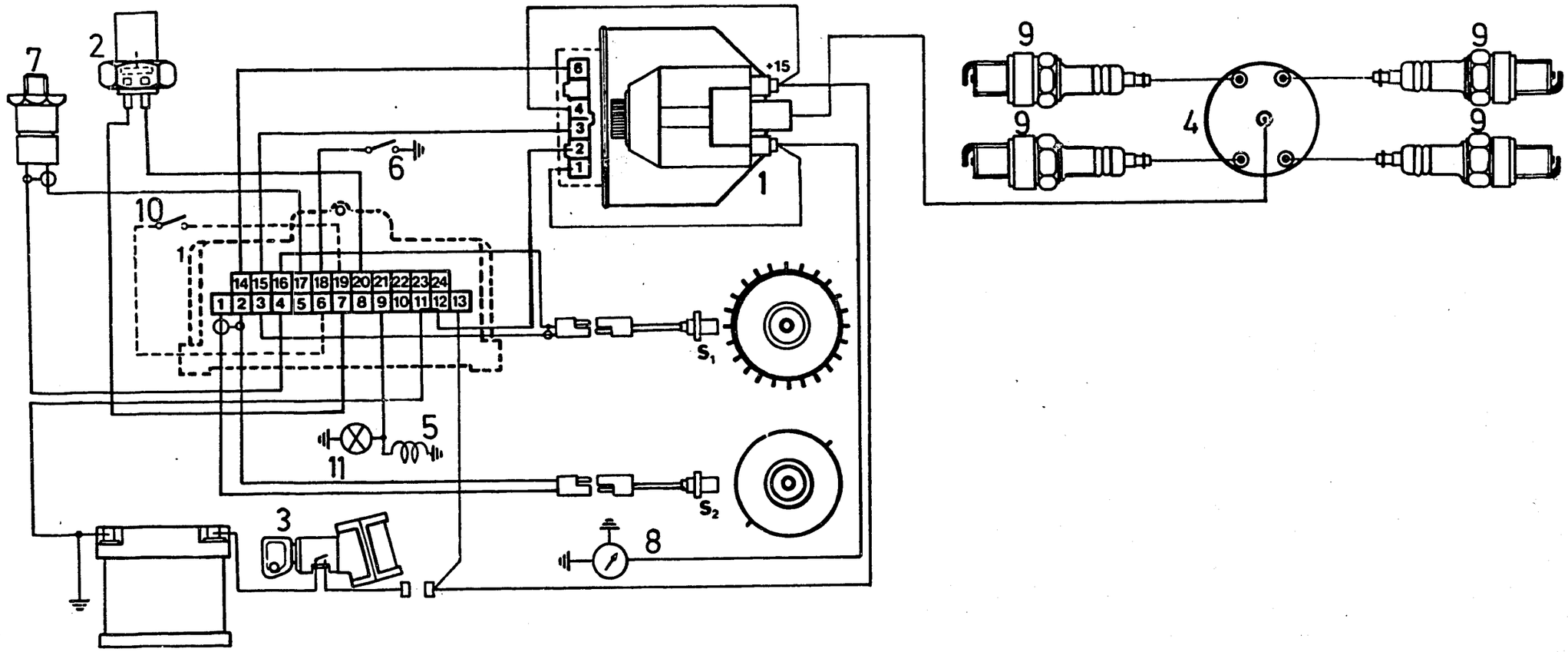


WS000083

4. Work instructions

The installation position of the TDC sensor with respect to the crankshaft pulley can be tested with the aid of the special tool 1 895 888 000.

For production reasons:
continued on the following coordinate.



WS000084

5. Electrical terminal diagram

1 = Ignition coil
2 = Overboost (safety pressure valve)
3 = Ignition and starting switch
4 = Ignition distributor
5 = Overboost solenoid valve
6 = Full-throttle switch
7 = Knock sensor
8 = Rev counter
9 = Spark plugs
10 = Ignition-timing retardation
11 = Overboost repeater lamp
S1 = Engine-speed sensor (flywheel)
S2 = TDC sensor (on crankshaft V-belt gear)

6. Technical Data

Engine	Type	2000 cc, Turbo
	Power	122 kW bei 5500 min $^{-1}$ Cat.110 kW at 5500 min $^{-1}$
Ignition system	Make	Magneti Marelli
	Type	Microplex
Firing order		1–3–4–2
Cylinder 1		near toothed-gear drive
Spark plugs	Make/Type	Bosch WR 6DC
	Electrode gap	0.6...0.7 mm
Ignition coil	Primary resistance	0.405...0.495 Ω
	Secondary resistance	4320...5280 k Ω
Ignition distributor	Make	Magneti Marelli
	Type	DT 402 BX
	Rotor resistance	1.0 k Ω

Technical Data (Continued)

Ignition point	at idle	10° before TDC
	Cat.	15° before TDC
Idle speed		850...900 min $^{-1}$
Control unit	Make	Magneti Marelli
Engine-speed sensor	Type	Magneti Marelli SEN 8E
	Resistance	612...748 Ω
	Air gap	0.25...1.3 mm
TDC sensor	Type	Magneti Marelli SEN 8D
	Resistance	612...748 Ω
	Air gap	0.4...1.0 mm

This microcard was prepared exclusively for Bosch Service on behalf of ROBERT BOSCH GMBH STUTTGART

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto-Technik" magazine published by the AT-Fachschriftenverlag AG, CH-5001 Aarau.

The BOSCH equipment and the test specifications/ settings for BOSCH products and components are always to be taken from the BOSCH microcards. Test specifications and circuit diagrams are contained in the microcards and workshop documentation already introduced into BOSCH after-sales-service workshops.

For production reasons: continued on the following coordinate.

VW Golf 1985->1986;
VW Jetta 1985->1986;
VW Scirocco 1981

Engine code letters KR and PL

IGNITION SYSTEM

1. Construction and Operation

The 16-valve engines, Types KR and PL, with 1.8 l swept volume are equipped with a fully electronic ignition system (FEI). An electronic control unit measures the vacuum in the intake manifold, the engine temperature, the engine-speed signal, and the throttle-valve position. The PL engine with 3-way catalytic converter is additionally equipped with knock control. The control unit passes the ignition pulse determined according to a characteristic map to the TCI-H trigger box. Furthermore, the FEI control unit controls engine-speed limitation at 7000...7300 min^{-1} .

The Hall generator is installed in the ignition distributor.

The knock sensor is mounted in the front of the engine block.

The throttle-valve switch specifies the positions for idle and full load to the control unit (PL engine only).

Safety instructions

Observe the following instructions whenever working on vehicles equipped with a fully electronic ignition system:

- Do not touch or disconnect ignition cables when the engine is running or the starting motor turning!
- Do not connect or disconnect any cable of the ignition system when the ignition is switched on.
- If the engine is to be operated only at starting-motor speed, disconnect the main ignition cable from the ignition distributor and connect it to ground.
- Starting aid using a boost battery charger is permissible only for a period of 1 minute at a maximum of 16.5 V.
- Switch off the ignition when cleaning the engine!
- Disconnect the battery when carrying out electrical welding work!
- When towing away vehicles with a defect in the ignition system, disconnect the plug from the output stage!
- If the vehicle is to be heated in a drying oven (for paint work), start the engine only after it has cooled down!

After-sales Service

Technical Bulletin

Packaging of goods under warranty

438

K-Jetronic (CIS)

VDT-I-438/101 B
10. 1976

All components or assemblies of the K-Jetronic which are dispatched under warranty must be correctly and carefully packaged so that no further damage or impairments occur during transit, since these would not be covered by warranty.

Any fuel remnants must be removed from those K-Jetronic assemblies intended for dispatch, so as to eliminate any danger of fire during transit.

The intake openings and outlets of the assemblies must be sealed off with caps or plugs. As new products were fitted, the caps or plugs from these may be used.

The plunger of the fuel distributor is to be fitted with a protective cap of adequate size, or secured to the fuel distributor.

In addition, the assemblies are packed in tightly packed, well-sealed plastic sleeves. Fuel distributors and warm-up regulators are packed individually.

If components arrive damaged due to incorrect packaging or do not comply with these instructions, they can be returned and the warranty claim rejected.

BOSCH Geschäftsbereich KH Kundendienst, Kfz-Ausrüstung.

After-sales Service

Technical Bulletin

Securing of idle-speed adjusting screws

K-Jetronic (CIS)

438

VDT-1-438/102 B
11.1976

According to a statutory regulation, changes have been made to § 47 of the German traffic licensing laws concerning exhaust gases and their outlets. This regulation was printed in full in traffic law sheet 13 of 15.7.75 .

Consequently, all motor vehicles with external-ignition engines must have their idle-speed adjusting devices secured from the 1st October 1976, so that adjustment of the screw is impossible without destroying the securing device. This should stop unskilled people from adjusting the installation of the idle-speed system and thereby illegally influencing the emission values. As from now, securing caps can only be used in the workshop and cannot be sold to customers for their own use.

Securing caps are produced in various colors. For after-sales service the following caps and colors are used:

downdraft air-flow sensor	
Blue	securing cap is not available from BOSCH. Part number is DB 000.997.59 86 from the Deutsche Vergaser Gesellschaft K 34 520
updraft air-flow sensor	
Red	Part number 3 430 522 002

These stipulations are only valid in countries where ECE regulations (Economic Commission for Europe) apply. The air-flow sensors must however be converted for the use of these securing caps, as a matter of principle. The caps can also be used in countries not subject to ECE regulations, to prevent dirt penetrating through the pipe to the adjustment in the case of updraft air-flow sensors.

BOSCH Geschäftsbereich KH Kundendienst, Kfz-Ausrüstung

Observe the following instructions when interference-suppressing the engine:

- Do not connect a capacitor to terminal 1 of the ignition coil!

- Do not exchange a distributor rotor marked with R1 (1 k Ω)!

- The ignition cables may have a maximum resistance of 1 k Ω and the spark plugs a maximum resistance of 5 k Ω .

2. Test equipment

The ignition system can be tested with the aid of a timing strobe, voltmeter, ohmmeter and voltage tester (with light-emitting diode).

After-sales Service

Technical Bulletin

EXCHANGEABLE NON-RETURN VALVES
in electric fuel pumps 0 580 254 ..

VDT-I-438/104 En
3.1983
(Replaces Ed. 5.1982)

Electric fuel pump	Parts set (non-return valve + seal ring)	Non-return valve	Seal
0 580 254 001	1 587 010 500	---	---
002	500	---	---
0 580 254 003	502	---	---
004	502	---	---
005	502	---	---
006	502	---	---
007	500	---	---
948	005	---	---
949	002	---	---
950	006	---	---
951	006	---	---
952	002	---	---
953	501	---	---
954	002	---	---
956	002	---	---
957	002	---	---
958	002	---	---
959	002	---	---
960	002	---	---
961	002	---	---
962	002	---	---
963	005	---	---

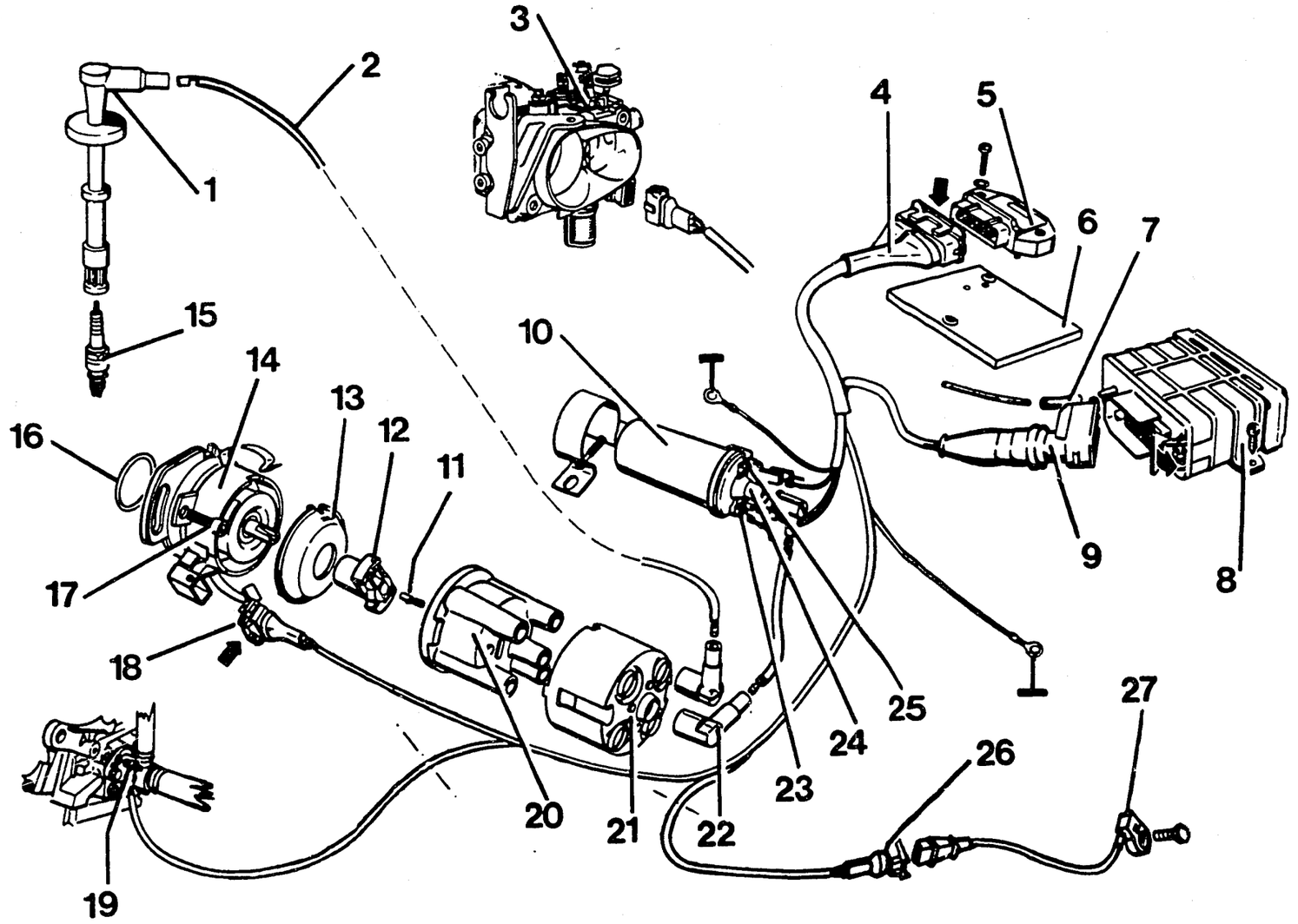
BOSCH
Geschäftsbereich KH Kundendienst. Kfz-Ausrüstung

Electric fuel pump	Parts set (non-return valve + seal ring)	Non-return valve	Seal ring
0 580 254 964	1 587 010 002	---	---
965	002	---	---
966	002	---	---
967	002	---	---
968	002	---	---
969	002	---	---
970	002	---	---
971	002	---	---
972	002	---	---
973	002	---	---
974	002	---	---
975	003 ④	---	---
976	004 ③	---	---
977	004 ③	---	---
978	1 587 410 901	---	---
979	010 004 ③	---	---
980	002	---	---
981	002	---	---
982 ①	003 ④	---	---
982 ②	1 587 410 901	---	---
984	010 004 ③	---	---
985	---	1 583 385 006	1 580 203 002
986	---	386 011	001
987	---	008	001
988	---	008	001
989	---	008	001
990	---	385 004	002
991	---	004	002
992	1 587 010 001	---	---
996	---	386 011	001
998	---	385 004	002
9 580 234 003	002	---	---
005	002	---	---

1 = up to FD 822 2 = from FD 823

3 = Parts set ..003 also possible (delivery-line connection at 90°)

4 = Parts set ..004 also possible (delivery-line connection axial)



WS000085

Components of the fully electronic ignition system (FEI)

1 = Spark-plug connector
2 = Ignition cable
3 = Throttle-valve switch
4 = Plug
5 = TCI-H trigger box
6 = Heat sink
7 = Vacuum line
8 = FEI control unit
9 = Plug
10 = Ignition coil
11 = Carbon brush with spring
12 = Distributor rotor
13 = Dust-protection cap
14 = Ignition distributor
15 = Spark plug
16 = O-ring
17 = Screw
18 = Plug
19 = Temperature sensor
20 = Distributor cover
22 = Suppressor
23 = Terminal 15
24 = Connection
25 = Terminal 1
26 = Plug
27 = Knock sensor

After-sales Service

Motor Vehicle Service Information

EXPORT VEHICLES WITH
EMISSION CONTROL SYSTEMS

VDT-I-Gen. 042 En.
12. 1981

K-Jetronic and L-Jetronic

Export vehicles for countries with stringent exhaust emission regulations are equipped with various emission control systems. To meet the legal requirements, these systems are installed either individually or in combination, depending on the model version.

Emission control system	installed predominantly in export vehicles				
	Sweden	Australia	Canada	USA	Japan
Exhaust-gas recirculation*	●	●	●	(●)	(●)
Secondary-air induction*	●	●	●	(●)	(●)
Secondary-air injection*	●	●	●	(●)	(●)
Catalytic converter*	-	-	-	●	●
Lambda closed-loop control	-	-	-	●	●

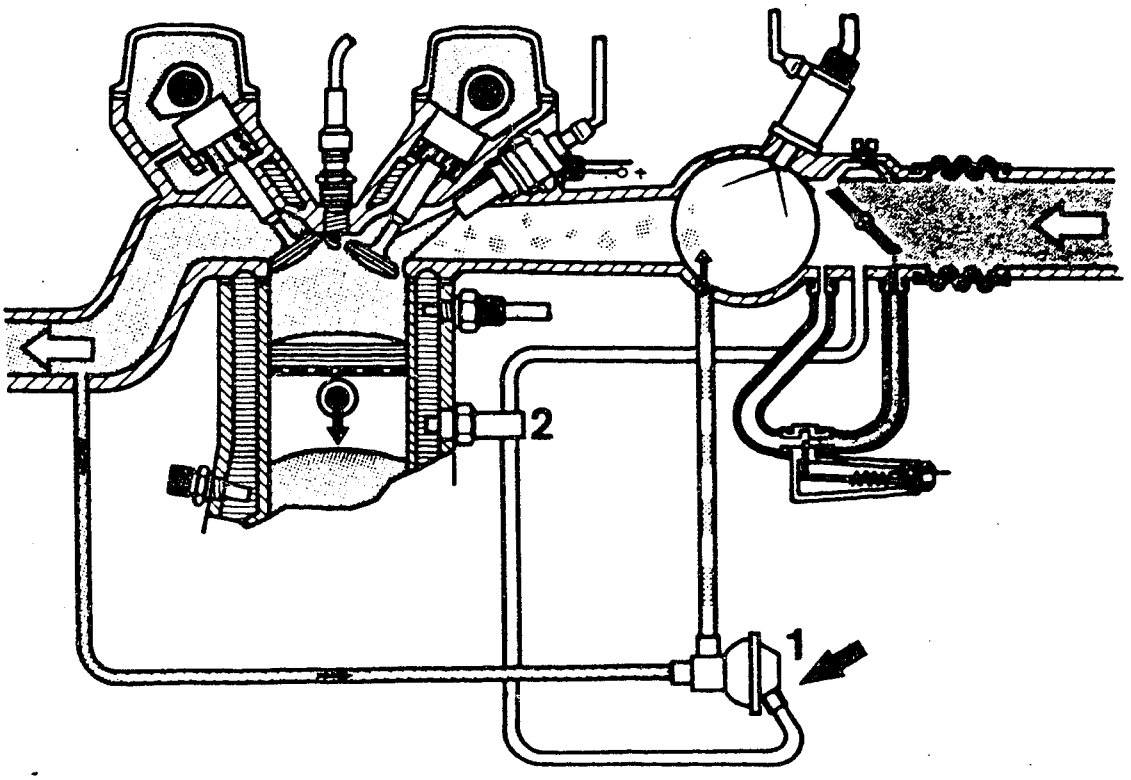
The vehicle-related After-Sales Service Instruction Manuals for the K-Jetronic and L-Jetronic describe the construction, function and operating principle of the emission control systems. The influence of these systems should be borne in mind particularly when adjusting the idle speed and CO concentration.

Export vehicles are sometimes also encountered in countries which do not have particularly stringent exhaust emission legislation. This Service Information publication summarizes the various emission control systems and provides information for the After-Sales Service in countries with exhaust emission legislation which does not require such emission control systems or unleaded fuel.

* Not made by Bosch

BOSCH
Geschäftsbereich KH Kundendienst Kfz-Ausrüstung

1. Exhaust-gas recirculation (EGR)



1 = Exhaust-gas recirculation valve 2 = Thermo-valve

Some of the exhaust gas is returned to the intake manifold via a vacuum-controlled exhaust-gas recirculation valve. This recirculation of exhaust gas into the combustion chamber lowers the combustion temperature and reduces the emission of nitrogen oxides (NOx). The thermo-valve and the position of the vacuum tapping port on the throttle-valve assembly ensure that exhaust gas is only recirculated when the engine is warm and only at part load. There is a reduction in engine speed of about 200 min^{-1}. Exhaust-gas recirculation is inoperative at idle, full-load and when the engine is cold.

When testing or adjusting the idle speed and CO concentration, remove and seal off the vacuum control line (arrow) on the exhaust-gas recirculation valve in order to ensure that the exhaust-gas recirculation system is inoperative.

In countries without stringent exhaust emission legislation it is not necessary to shut down the system.

3. Testing the individual components

Execution of the test procedures in the following sequence necessitates in each case perfect results from the preceding measurements.
FEI control unit and TCI-H trigger box of the PL engine are installed right next to the control unit of the K-Jetronic.

There are two versions of the knock sensor fitted to the PL engine, the difference being the cable output:

Version I = Cable output at side
Version II = Cable output at center

The testing and setting procedures for the throttle-valve switch correspond to the specifications for the K- and KE-Jetronic.

a) The ignition point is tested at idle speed. The markings are located on the flywheel and clutch housing.

- Conditions:
  Engine speed 950...1000 min $^{-1}$
  Engine-oil temperature at least 60°C (KR)
  at least 80°C (PL)

  Throttle-valve switch closed

- Test specification 4...8° before TDC

- Setting 5...7° before TDC

b) Check the ignition-point advance as a function of the engine speed:

KR engine:

- With the vacuum hose disconnected, the timing advance between idle speed and 4600 min $^{-1}$ must amount to approx. 18°

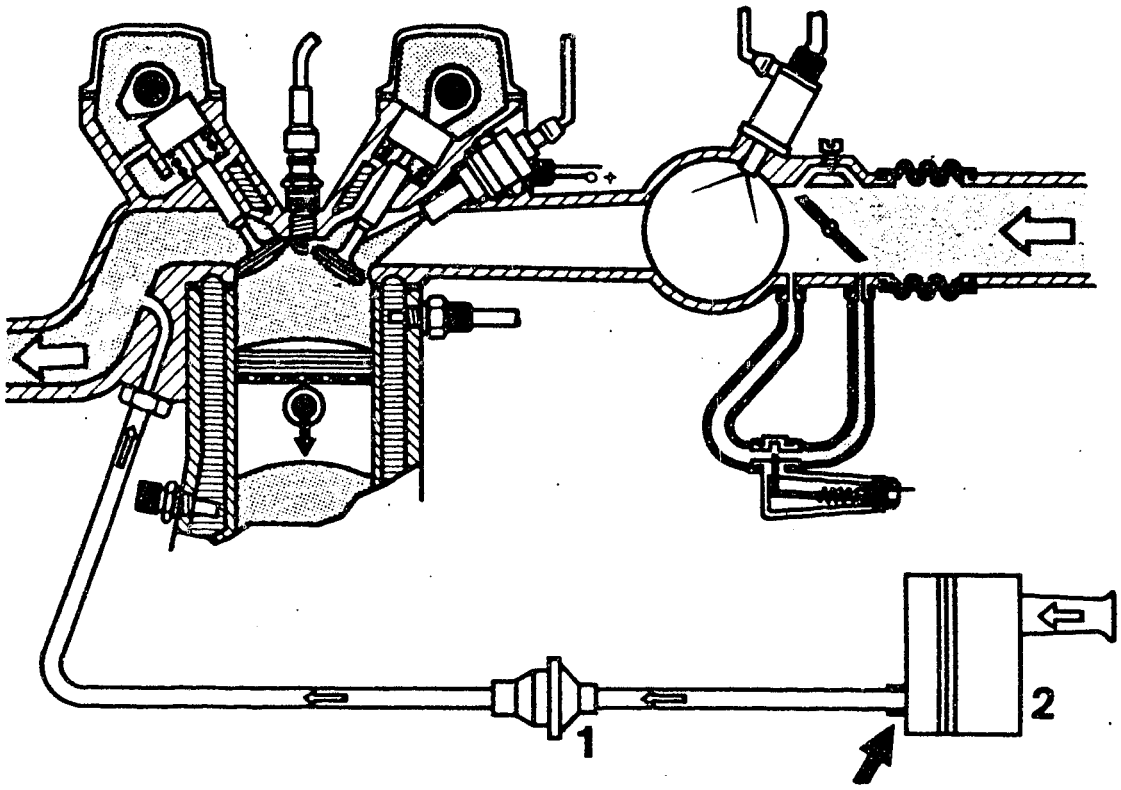
- With the vacuum hose connected, the ignition timing must be advanced by a further 20° when the engine speed is increased from idle to 4600 min $^{-1}$.

PL engine:

- With the vacuum hose disconnected, the timing advance between idle speed and 2500 min $^{-1}$ must amount to approx. 13°.

- With the vacuum hose connected, note down the ignition advance between idle speed and 3400 min $^{-1}$. When repeating the test with the vacuum hose disconnected, the ignition timing must be advanced by a further 6°.

2. Secondary-air induction (e.g. Volvo Pulsair system)



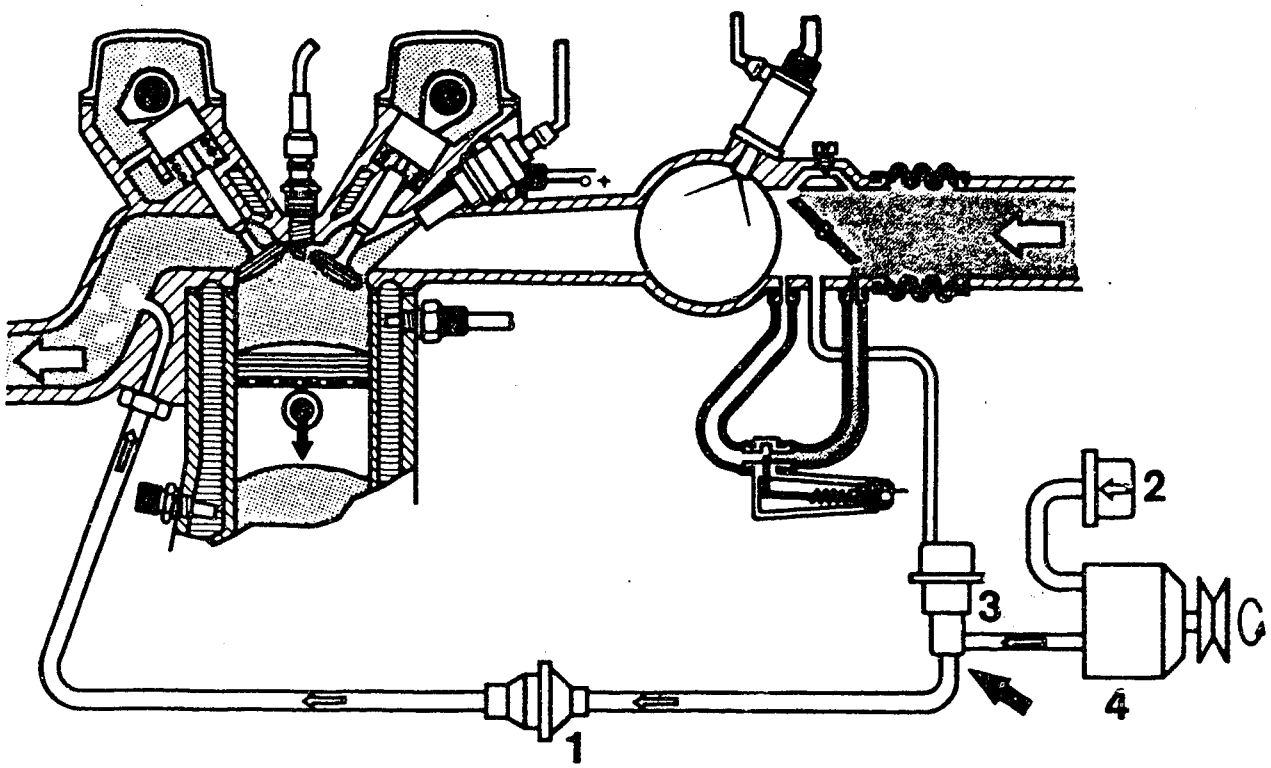
1 = Non-return valve 2 = Air filter

The pulsating alternation between overpressure and depression in the flow of exhaust gas inducts fresh air into the exhaust ports via a non-return valve. Unburned residues of carbon monoxide (CO) and hydrocarbons (HC) are partially after-burned, leading to fewer pollutants in the exhaust gas.

When testing or adjusting the idle speed and the CO concentration, the secondary-air induction system must be rendered inoperative. To do this, remove the hose between the non-return valve and the air filter on the air filter (arrow) and seal off tight with a plug.

In countries without stringent exhaust emission legislation it is not necessary to shut down the secondary-air induction system.

3. Secondary-air injection



1 = Non-return valve
2 = Air filter
3 = Change-over valve
4 = Air pump

An air pump driven by the engine inducts fresh air through the air filter and forces it via a non-return valve into the exhaust ports. As in the case of secondary-air induction, there is a partial after-burning of the CO and HC residues. This makes the exhaust gas cleaner. A vacuum-controlled change-over valve controls the operation of the secondary-air injection system.

When testing or adjusting the idle speed and the CO concentration, shut down the secondary-air injection system. To do this, remove the hose from the outlet of the change-over valve (arrow) and seal off tight with a plug.

In countries without stringent exhaust emission legislation it is not necessary to shut down the secondary-air injection system.

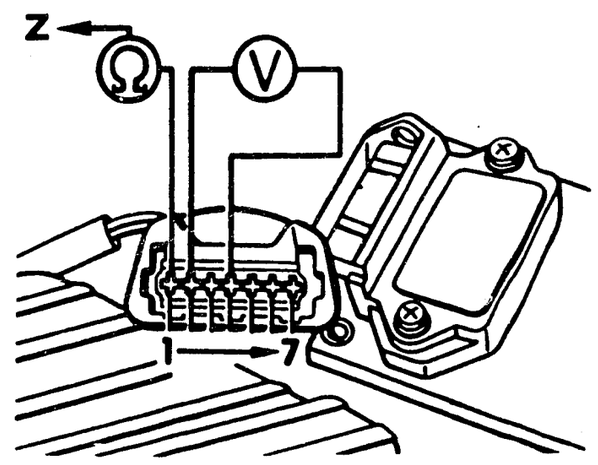
c) Test the ignition coil in accordance with the resistance values in the table (coordinate 24).

d) The input voltage of the TCI-H trigger box can be measured at the disconnected plug using a voltmeter and ohmmeter:

- With the ignition switched on, approx. battery voltage must be applied. If this is not the case, there is probably an open circuit in a lead.

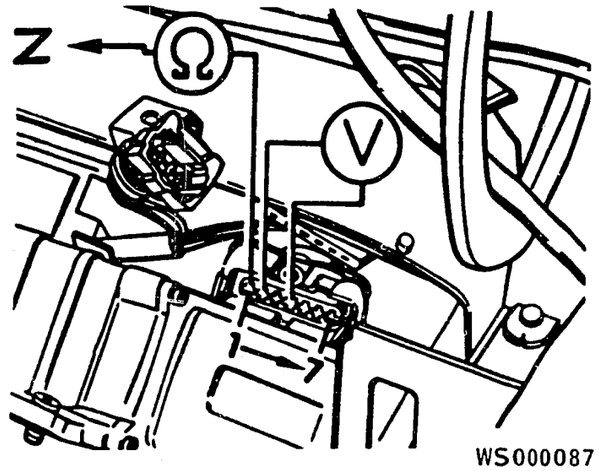
Engine type KR: Measure the input voltage and the TCI-H trigger box at terminals 2 and 4 using a voltmeter and measure the power continuity from terminal 1 to the ignition-coil connection 1 (2) using an ohmmeter (upper illustration).

Engine type PL: With the engine type PL, measure the voltage between the terminals 2 and 4 using a voltmeter, and measure the power continuity between the plug terminal 1 and the ignition--coil connection 1 (2) using an ohmmeter (lower illustration).

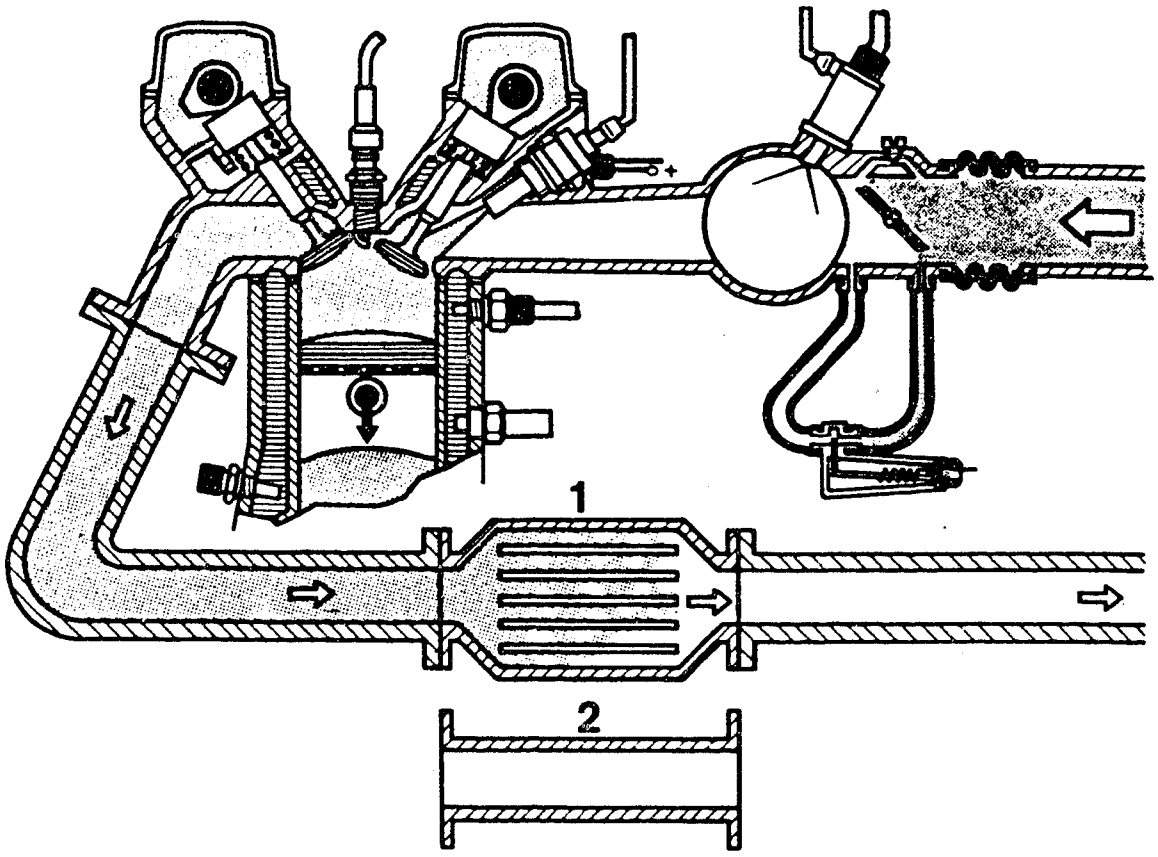


Engine type KR

Engine type PL



4. Catalytic converter



1 = Catalytic converter 2 = Intermediate pipe

The single-bed catalyst installed in the exhaust system in export vehicles (also with lambda closed-loop control) reduces all three pollutants CO, HC and NOx to a minimum. The catalytic surface triggers chemical reactions of the pollutants, rendering them non-toxic.
Important: Proper operation only possible in conjunction with unleaded fuel (at present only in USA and Japan).

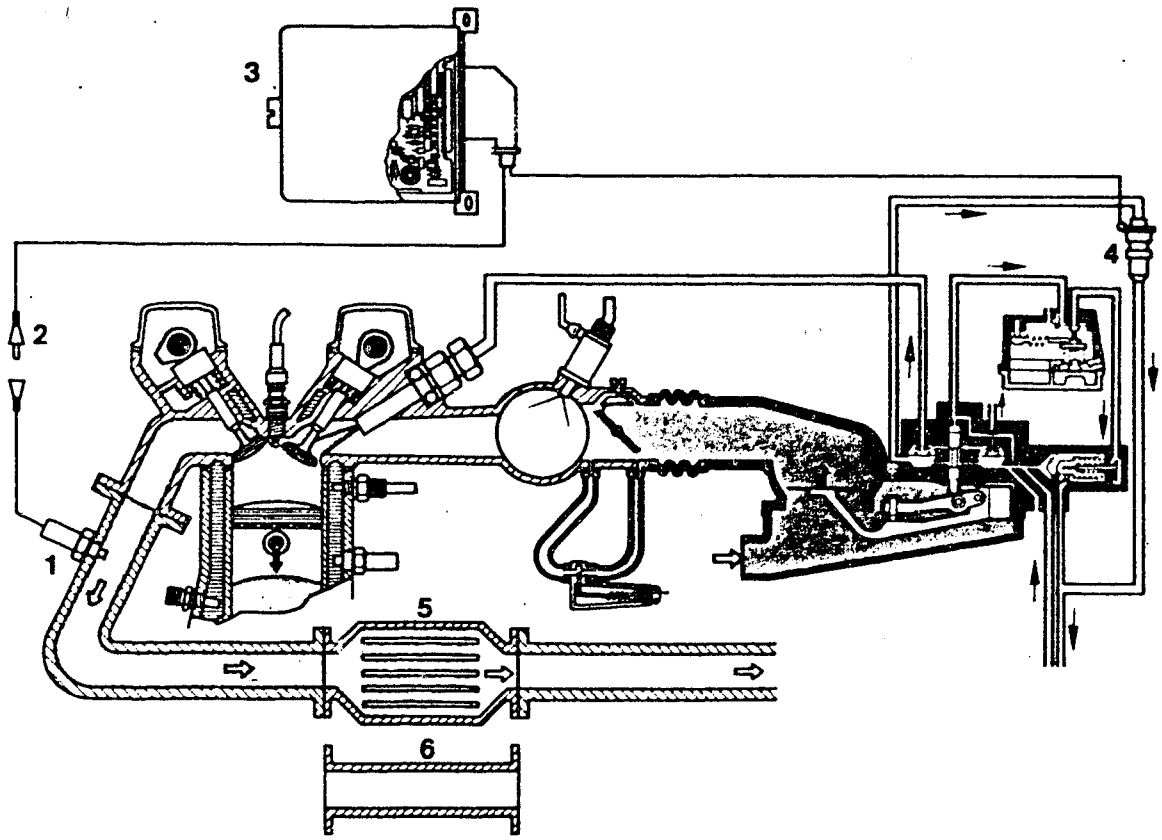
When testing or adjusting the idle speed and the CO concentration, the catalytic converter can be neglected since the exhaust-measuring point is upstream of the catalyst.

Caution!

If the vehicle is operated on leaded fuel (predominantly in countries without stringent exhaust emission legislation) the catalytic converter must be removed. If not removed, the catalytic converter would become clogged up and lead to a reduction in the power output of the engine.

Appropriate intermediate pipes for converting the exhaust system are available from the vehicle manufacturer.

5. Lambda closed-loop control

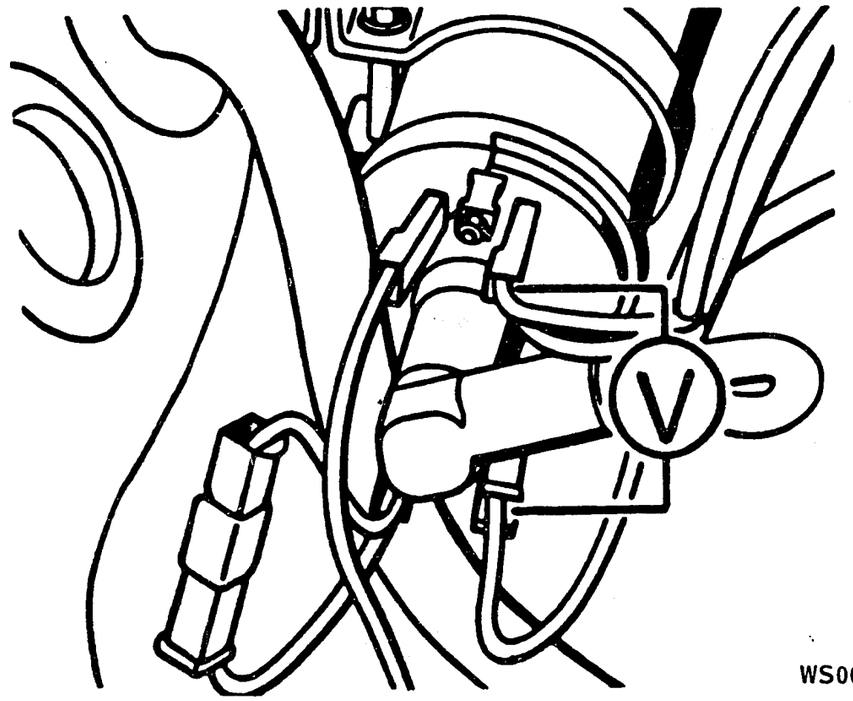


1 = Lambda sensor
2 = Plug
3 = Control unit
4 = Timing valve
5 = Catalytic converter
6 = Intermediate pipe

Export vehicles for the USA and Japan are equipped with lambda closed-loop control. This additional function of the K-Jetronic or L-Jetronic is not a downstream emission control system, but ensures a low pollutant content in the exhaust gas by means of optimum mixture preparation. Additional exhaust-gas recirculation, secondary-air induction or secondary-air injection is therefore not necessary in most cases. Like the catalytic converter, the lambda sensor (in the exhaust gas) operates only with unleaded fuel.
If the vehicle is operated on leaded fuel, the lambda sensor becomes clogged up and ceases to operate. The control unit detects this and switches from closed-loop to open-loop control. The system then operates on a fixed air-fuel ratio in the same manner as a K-Jetronic or L-Jetronic without lambda-closed-loop control. Before operating on leaded fuel, the lambda sensor should be removed and the installation hole should be closed off with a screw plug M18x1.5 (length of thread max. 8.5 mm). The disconnected plug (2) of the sensor connecting cable should be insulated and fastened to a suitable place on the vehicle body.

Caution!
Under no circumstances must the control unit or the timing valve be shut down on the lambda closed-loop control of the K-Jetronic.
The catalytic converter should be replaced by an intermediate pipe.

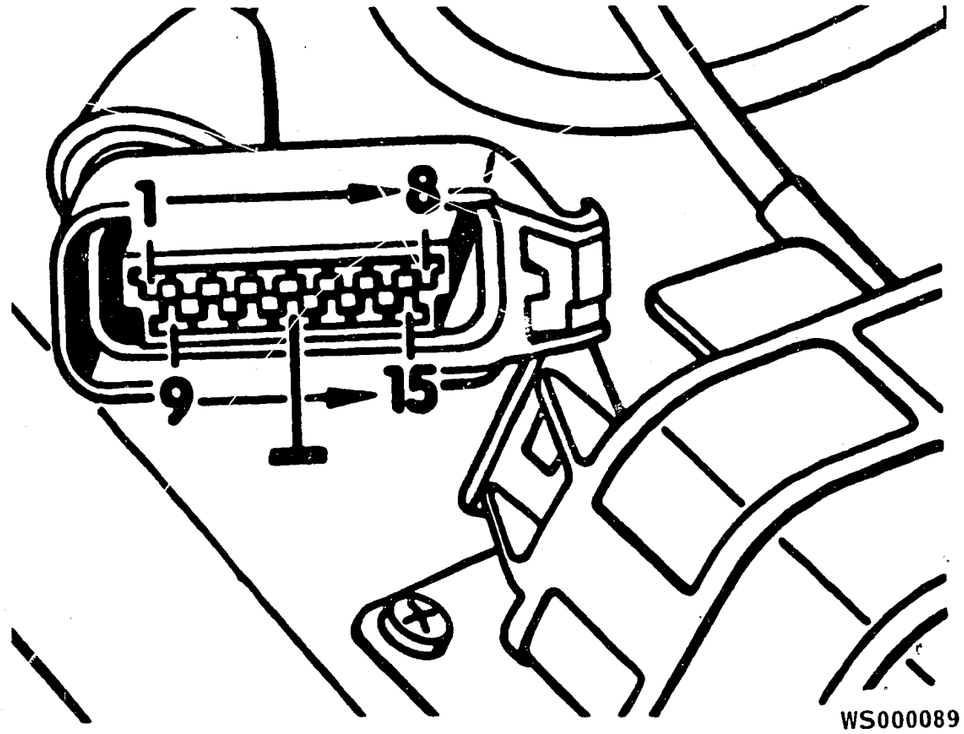
Published by:
Robert Bosch GmbH
Division KH
After-Sales Service Department
for Training and Technology
(KH/VSK)



WS000088

After doing this, reconnect the plug to the TCI-H trigger box and disconnect the plug from the FEI control unit. Connect a voltmeter to the ignition coil (upper illustration).

When the ignition is switched on, the voltmeter must indicate at least 2 V and fall back to 0 V after 1 to 2 s. If this does not happen, replace the TCI-H trigger box and check the ignition coil to see if sealing compound has escaped.



WS000089

When connection 12 of the trigger-box plug is briefly connected to ground (upper illustration), the voltage must in turn briefly rise to at least 2 V.

If this does not happen, replace the TCI-H trigger box.

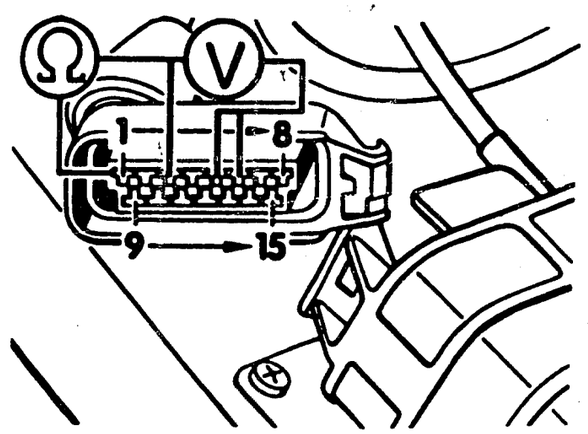
e) The FEI control unit can be tested at the connector, at the plug of the Hall generator and at the terminals of the ignition coil.

- Battery voltage must be measured in each case between terminals 3 and 5, and between 6 and 3 at the disconnected control-unit plug when the ignition is switched on
(upper illustration, engine type KR,
center illustration, engine type PL).

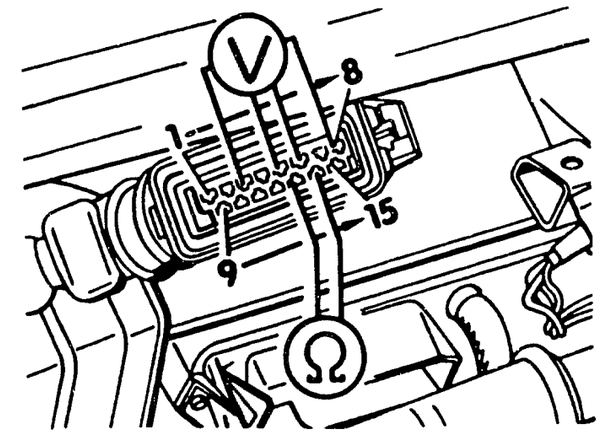
- When the throttle-valve switch is actuated, the voltage between terminals 6 and 3 must drop to 0 V.
If this is does not happen, test the idle switch.

- KR engine only: With the ignition switched off, measure the resistance value of the temperature sensor between terminals 1 and 3 and compare with the chart (lower illustration).

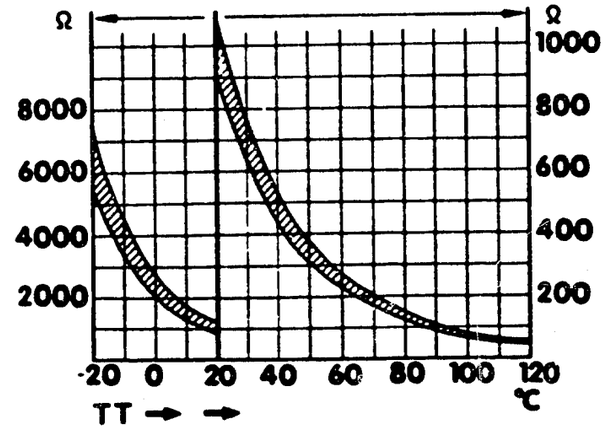
- PL engine only: When the throttle valve is opened, battery voltage must be measured between terminals 8 and 3 when the throttle valve is just before the full-throttle position.
If this does not happen, test the full-load switch.
The resistance of the knock sensor can be measured between terminals 13 and 14.
Set value: Version I = approx. 300 k Ω
Version II = approx. infinity Ω



WS000091



WS000092

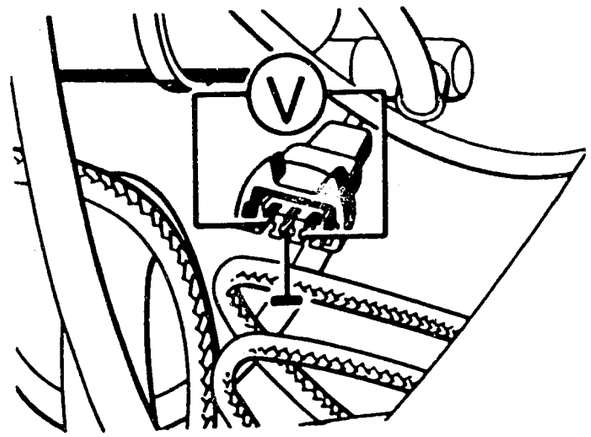


WS000122

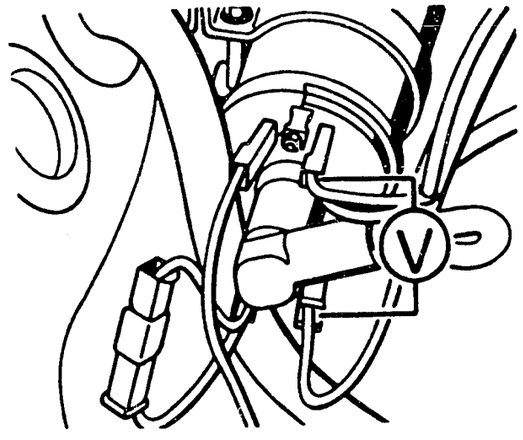
- Then reconnect the plug to the FEI control unit and disconnect the plug of the Hall generator. At least 5 V must be measured between the two outer terminals when the ignition is switched on (upper illustration).

- With the ignition switched off, connect the voltmeter to terminals 1 and 15 of the ignition coil (lower illustration).
  When the center terminal of the Hall-generator plug is briefly connected to ground (ignition switched on), the voltage must rise briefly to at least 2 V.
  If this does not happen, replace the control unit.

- In addition, the fuel pumps must start to operate during this test.
  If this does not happen, check the corresponding relays.



WS000090



WS000088

f) PL engine only: knock sensor, vacuum sensor in the control unit, and vacuum hose can be checked by connecting a voltage tester to the test plug and to B+ (upper illustration).

- On connecting, the diode must light up.

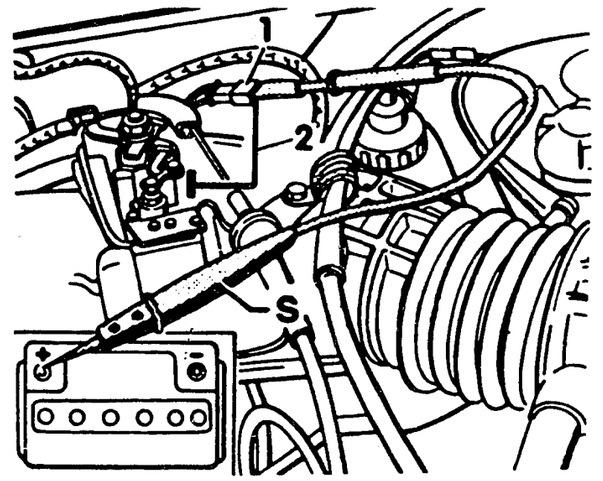
- When the engine is started, it must go out.

If the diode lights up again when the engine speed is increased to above 3000 min^{-1}, continue testing as follows:

- Using an auxiliary cable (2), apply the plug (1) to ground for at least 3 s and count the number of flashes.

  2 flashes : - knock sensor tightened incorrectly
  - open circuit in lead (knock sensor)
  - knock sensor defective
  - FEI control unit defective

  3 flashes : - vacuum hose defective
  - FEI control unit (vaccum sensor) defective.



WS000093

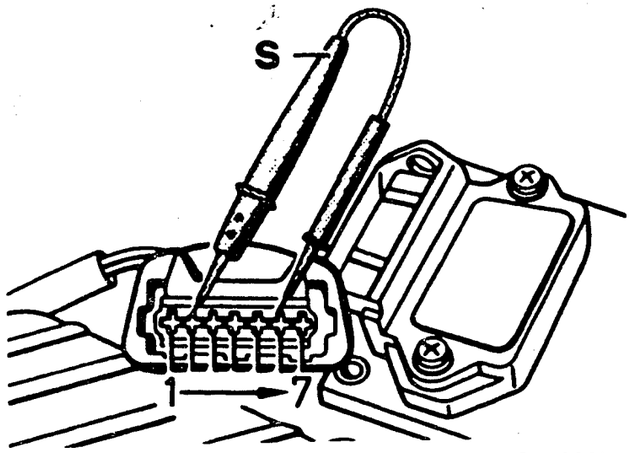
1 = Test plug
2 = Chassis connection
S = Voltage tester

g) The Hall generator can be tested by connecting a voltage tester to the terminals 2 and 6 of the disconnected TCI-H trigger-box plug.

- When the starting motor is actuated, the light-emitting diodes must flash on. If this does not happen, replace the Hall generator.

- KR engine type: (upper illustration)
  Voltage test at the disconnected TCI-H trigger-box plug at the terminals 2 and 6 using a light-emitting-diode-type voltage tester (S).
  Under no circumstances use a normal indicator lamp!

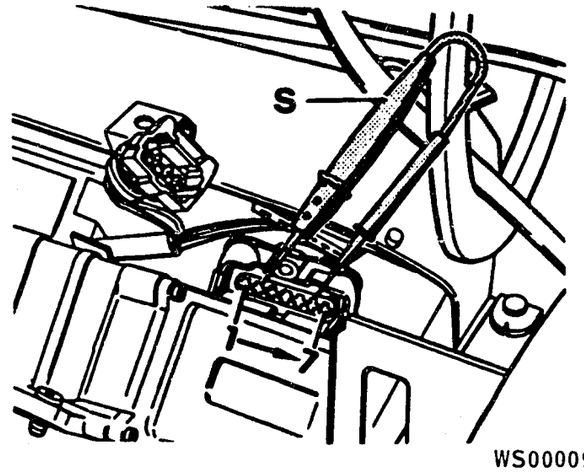
- PL engine type: (lower illustration)
  Voltage test at the disconnected TCI-H trigger-box plug at the terminals 2 and 6 using a light-emitting-diode-type voltage tester (S).
  Under no circumstances use a normal indicator lamp!



WS000094

KR engine type

PL engine type



WS000095

4. Work instructions

When tightening the fastening screw on the knock sensor, always observe the tightening torque of
10...12 Nm (version I), or
15...25 Nm (version II),
since operation of the sensor can be disrupted through improper tightening.

The spark plugs must be tightened to 20 Nm.

The ignition-distributor rotor bonded on to the shaft must be crushed with a pair of pliers if it is to be replaced.

7. Technical Data (KR engine type)

Installed as of 06.85

Engine	Type	1.8 1/102 kW
Ignition system	Make/Type	FEI
Firing order		1-3-4-2
Cylinder 1		
Spark plugs	Make/Type	VW/Audi 191 905 450 J Bosch F6 DTC 14F-6DTU Champion C6BYC
	Electrode resistance	0.7...0.9 mm
Ignition coil	Primary resistance	0.5...0.8 Ω
	Secondary resistance	2.4...3.5 k Ω
FEI control unit		811 907 384
Ignition point	Test specifications	4...8° before TDC
	Setting	6 ± 1° before TDC
Engine speed		950...1000 min $^{-1}$
Engine-speed limiter		7000...7300 min $^{-1}$

Table of contents

7. Technical Data (PL engine type)

Installed as of 03.86

Engine	Type	1.8 l/95 kW
Ignition system	Make/Type	FEI
Firing order		1-3-4-2
Cylinder 1		
Spark plugs	Make/Type	VW/Audi 191 905 450 J Bosch F6 DTC 14F-6DTU Champion C6BYC
	Electrode resistance	0.7...0.9 mm
Ignition coil	Primary resistance	0.6...0.8 Ω
	Secondary resistance	6.5...3.5 k Ω (yellow) 6.9...8.8 k Ω (gray)
FEI control unit		811 907 397 E
Ignition point	Test specification	4...8° before TDC
	Setting	6 ± 1° before TDC
Engine speed		800...900 min $^{-1}$
Engine-speed limiter		7200...7300 min $^{-1}$

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto-Technik" magazine published by the AT-Fachschriftenverlag AG, CH-5001 Aarau.

Table of contents (continued)

Table of contents (continued)

Automotive Equipment - After-Sales Service,
Department for Technical Publications KH/VDT,
Postfach 50, D-7000 Stuttgart 1

Published by: After-Sales Service, Department for Training and Technology (KH)VSK). Press date: 3.1983

Please direct questions and comments concerning the contents to our authorized representative in your country.

VW Golf / VW Jetta

Engine code letter RG

IGNITION SYSTEM

1. Construction and Operation

The 1.8 l engine, type RG, with open-loop-control catalytic converter is equipped with a fully electronic ignition system (FEI). An electronic control unit records the vacuum in the intake manifold, the engine-speed signal, the throttle-valve position and the signals from the knock sensor. The control unit passes the ignition pulse determined in accordance with the characteristic map to the TCI-H trigger box. Furthermore, the FEI control unit controls the engine-speed limitation function at 6570...6630 min^{-1} .

The Hall generator is installed in the ignition distributor.

The knock sensor is mounted on the front of the engine block.

The throttle-valve switch specifies the idle position to the control unit.

Safety instructions

When working on vehicles equipped with a fully electronic ignition system, make sure you observe the following instructions:

- Do not touch or disconnect ignition cables when the engine is running or the starting motor turning!
- Do not connect or disconnect the ignition-system cables when the ignition is switched on.
- If the engine is to be operated only at starting-motor speed, disconnect the main ignition cable from the ignition distributor and connect it to ground.
- Starting aid using a boost battery charger is permissible for only 1 minute at a maximum of 16.5 V.
- Switch off the ignition when cleaning the engine!
- Disconnect the battery when carrying out electrical welding work!
- When towing away vehicles with a defect in the ignition system, disconnect the plug from the output stage!
- If the vehicle is to be heated up in a drying oven (for stove-enamelling), start the engine only after it has cooled down!

When interference-suppressing the engine, observe the following instructions:

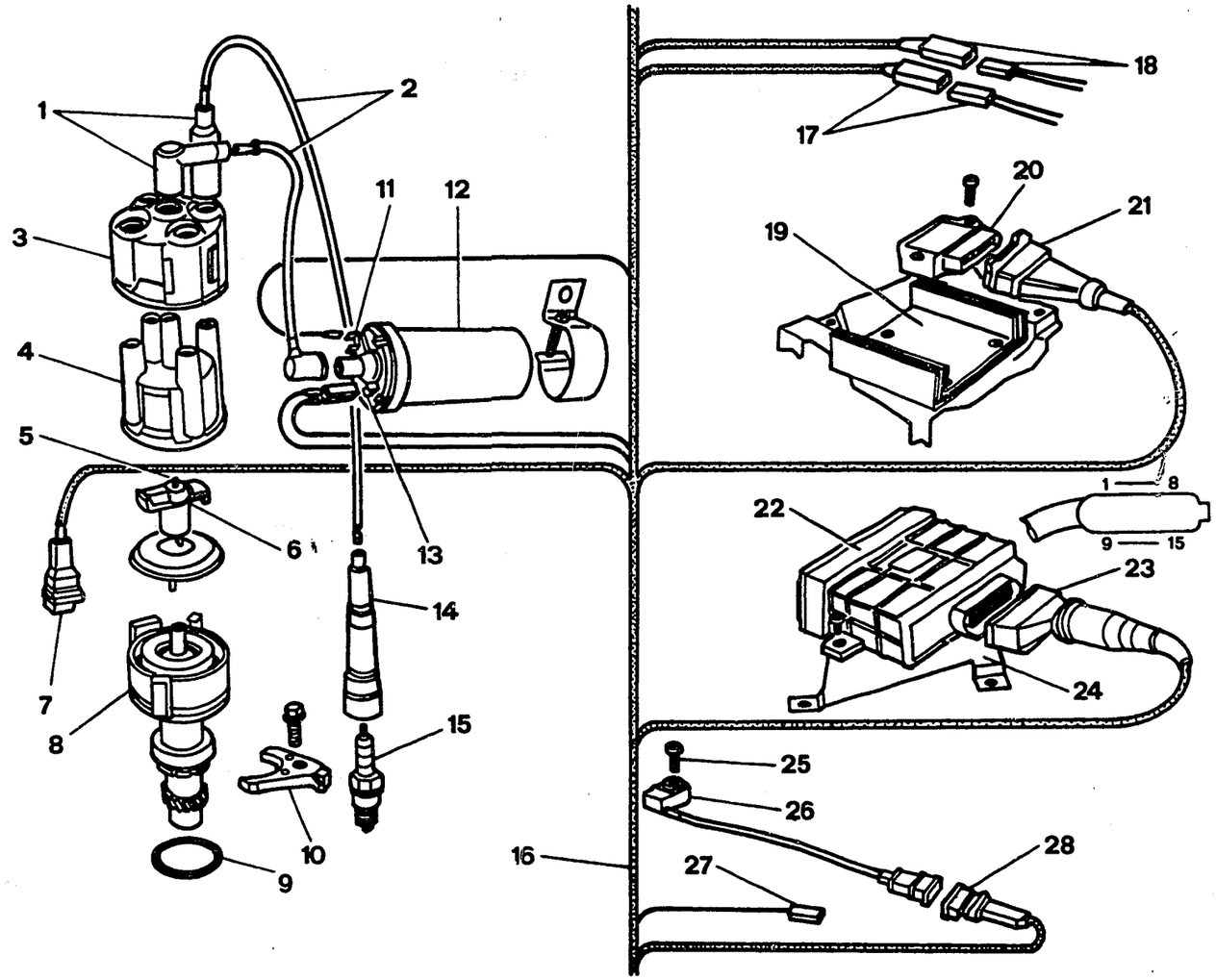
- Do not connect a capacitor to terminal 1 of the ignition coil!

- Do not exchange the distributor rotor marked with the identification code R1 (1 k Ω)!

- A maximum resistance value of 1 k Ω may be measured in the ignition cables and a maximum of 5 k Ω in the spark plugs.

2. Test equipment

The ignition system can be tested using a timing strobe, voltmeter, ohmmeter and voltage tester (with light-emitting diode).



FEI ignition system with knock control

1 = Suppressor
2 = High-voltage cable
3 = Interference-suppress. cap
4 = Distributor cover
5 = Carbon brush
6 = Distributor rotor
7 = Plug
8 = Ignition distributor
9 = O-ring
10 = Terminal with screw
11 = Terminal 1
12 = Ignition coil
13 = Terminal 15
14 = Spark-plug connector
15 = Spark plugs
16 = Wiring harness
17 = Lambda-sensor plug
18 = Plug, ignition and starting switch
19 = Heat sink
20 = Ignition trigger box
21 = Plug
22 = FEI control unit
23 = Plug
24 = Carrying plate
25 = Knock-sensor screw
26 = Knock sensor
27 = Test plug
28 = Plug, knock sensor

3. Testing the individual components

Execution of the test procedures in the following sequence necessitates in each case perfect results for the preceding measurements.

There are two versions of the knock sensor, the difference being in the cable output:

Version I = Cable output at side
Version II = Cable output at center

The testing and setting procedures for the throttle-valve switch correspond to the instructions given for the K-Jetronic.

a) The ignition point is tested at idle speed. The markings are located on the flywheel and clutch housing.

- Conditions:
  Engine speed 800...1000 min $^{-1}$
  Temperature, engine oil at least 80°C
  Throttle-valve switch closed
- Test specification 4...8° before TDC
- Setting 5...7° before TDC

For production reasons:
continued on the following coordinate.

b) Knock sensor, vacuum sensor in the control unit and vacuum hose can be checked by connecting a voltage tester (S) to the test plug and to B+ (upper illustration).

- When connecting the voltage tester, the diode must light up.

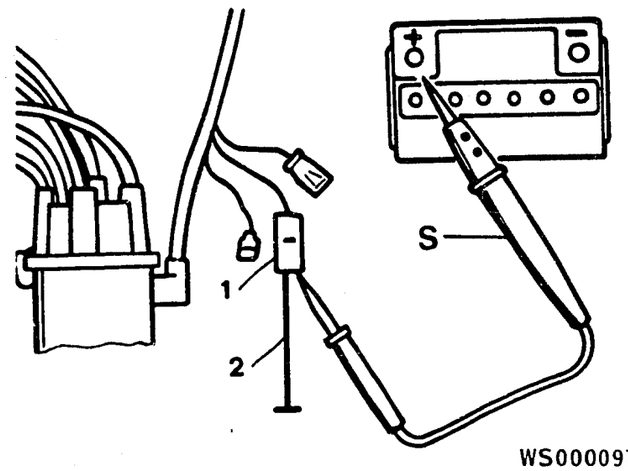
- When starting the engine and increasing the engine speed to above 3000 min^{-1}, the diode must go out.

If the diode lights up again, continue testing:

- Using an auxiliary cable, connect the plug to ground for at least 3 s and count the flashes.

2 flashes : - knock sensor tightened incorrectly
- open circuit in lead (knock sensor)
- knock sensor defective
- FEI control unit defective

3 flashes : - vacuum hose defective
- FEI control unit (vacuum sensor) defective.



WS000097

1 = Test plug
2 = Auxiliary cable as ground cable

c) Check the ignition-point advance as a function of the engine speed:

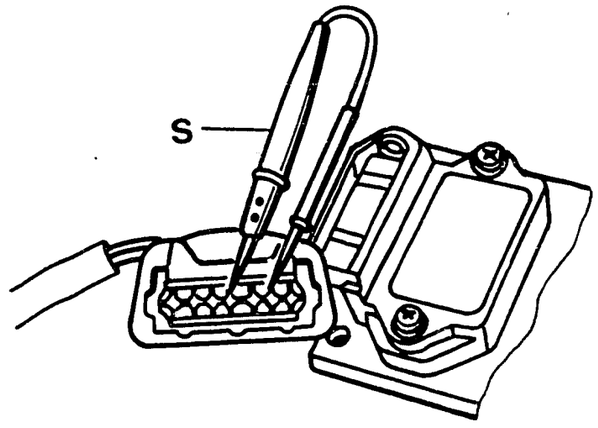
- With the vacuum hose disconnected, the ignition timing must be advanced by approx. 16° when the engine speed is increased from idle to 3000 min^{-1}.

d) Test the ignition coil in accordance with the resistance values in the table (coordinate 17).

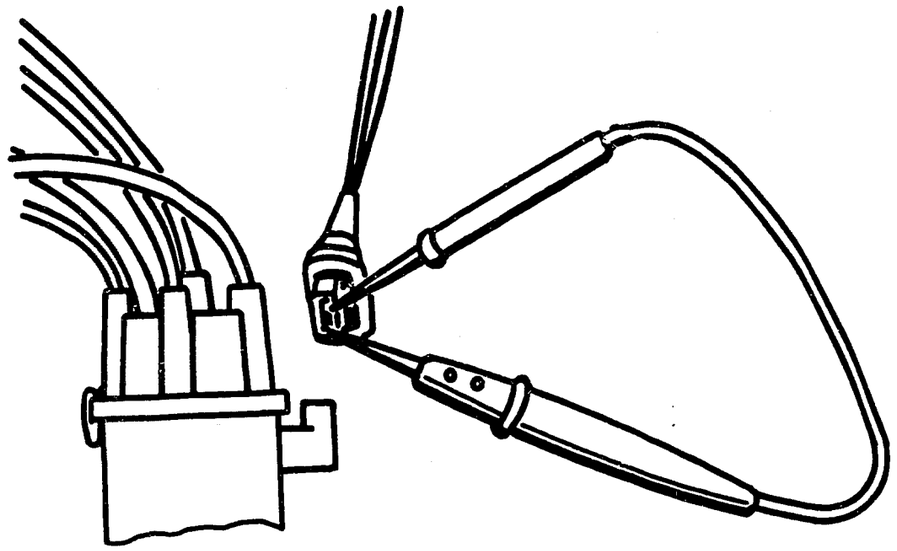
e) The Hall generator must be tested only if there is no ignition spark available.
To do this, disconnect plug from the TCI-H trigger box and connect the voltage tester (S) in accordance with the lower illustration (terminals 4 and 6).

- Flickering of the light-emitting diode when the starting motor is actuated indicates that the Hall generator is operating.

Hall-generator test using voltage tester S



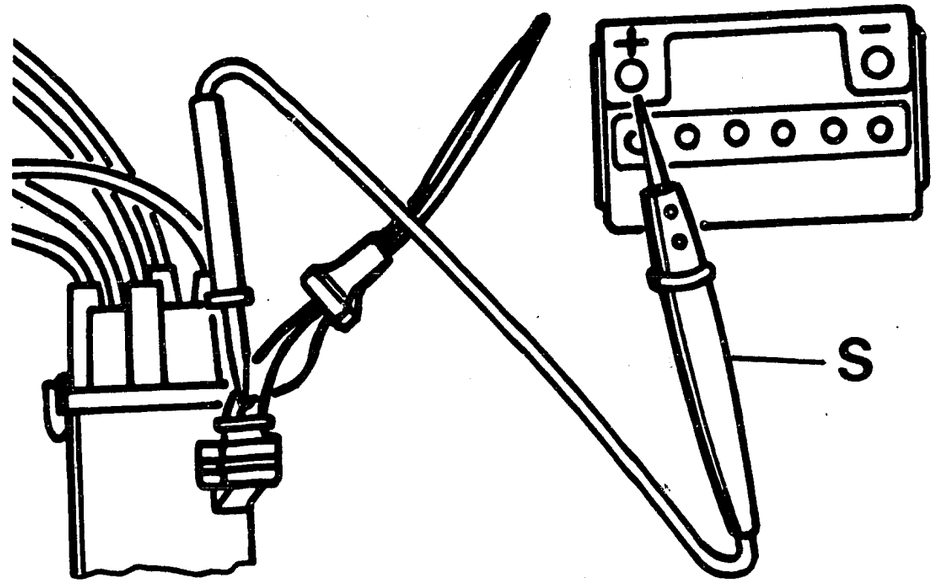
WS000098



WS000099

Test voltage supply on the Hall generator.

Disconnect plug from the Hall generator and check the voltage supply from the control unit with the ignition switched on (see illustration).



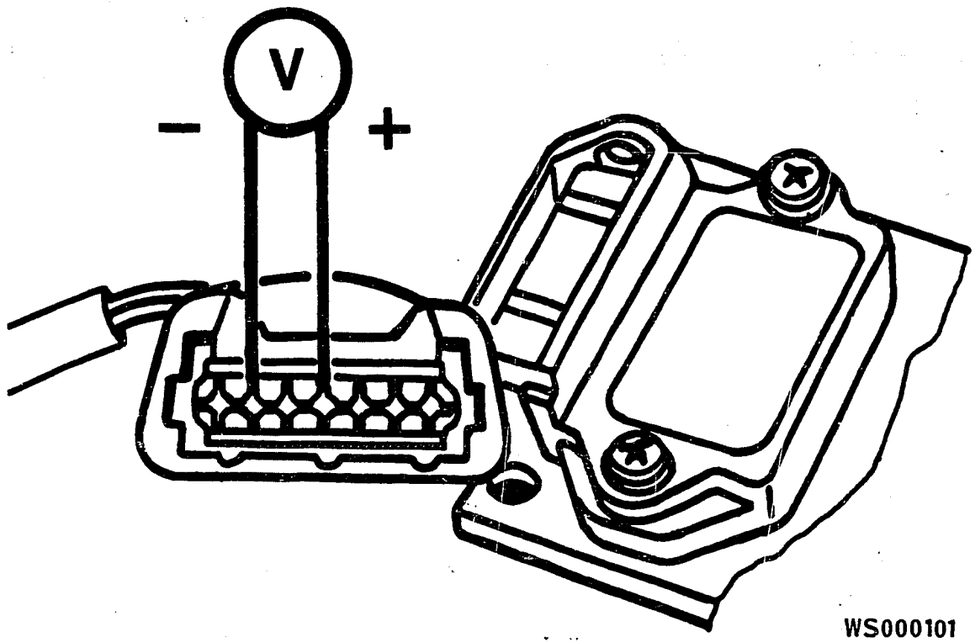
WS000100

Testing the Hall-generator signal.

Reconnect the plug with the rubber sleeve removed.

Test the signal on the Hall generator using a voltage tester with the starting motor turning (upper illustration).

If the light-emitting diode of the voltage tester does not flicker, the Hall generator and/or the control unit are defective.

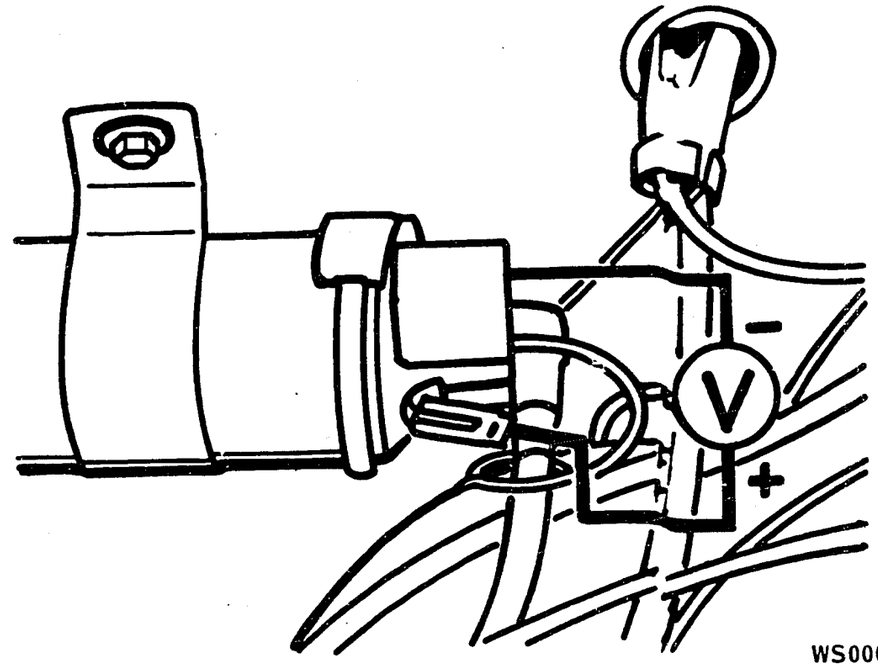


WS000101

Measure input voltage of the TCI-H trigger box.

f) The input voltage of the TCI-H trigger box (terminals 2 and 4) can be measured at the disconnected plug (see illustration) using a voltmeter:

– With the ignition switched on, approx. battery voltage must be measured. If this is not the case, there is probably an open circuit in a lead.

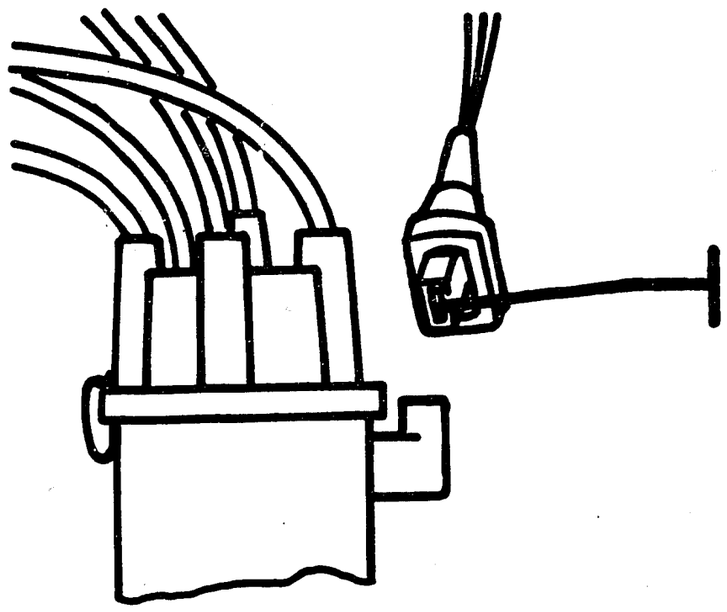


WS000102

Voltage measurement at the ignition coil.

Reconnect the TCI-H trigger box, disconnect the plug from the Hall generator, and connect the voltmeter to the ignition coil (illustration).

When the ignition is switched on, the voltmeter must indicate at least 2 V and drop back to 0 V after 1 to 2 s. If this does not happen, replace the TCI-H trigger box and check whether sealing compound has escaped from the ignition coil.



WS000103

Test of the TCI-H trigger box

When the center terminal of the Hall-generator plug is briefly connected to ground (upper illustration), the voltage must in turn fall back to 0 V after approx. 2 s.
If this does not happen, replace the TCI-H trigger box.

The cables can be checked for open circuit at the disconnected plug of the FEI control unit.

4. Work instructions

When tightening the fastening screw of the knock sensor, always observe the tightening torque of
10...12 Nm (Version I) or
15...25 Nm (Version II),
since operation of the knock sensor is disrupted if it is not tightened properly.

Tighten the spark plugs to 20 Nm.

The ignition-distributor rotor bonded on to the shaft must be crushed with a pair of pliers if it is to be replaced.

7. Technical Data

Engine	Type	1.8 1/66 kW
Ignition system	Make/Type	FEI
Firing order		1-3-4-2
Cylinder 1		
Spark plugs	Make/Type	VW/Audi 191 905 450 A Bosch W7 DTC Beru 14-7 DTU Champion N7BYC
	Electrode resistance	0.7...0.9 mm
Ignition coil	Primary resistance	0.52...0.76 Ω
	Secondary resistance	2.4...3.5 k Ω
Ignition point	Test specification	4...8° before TDC
	Setting	6 ± 1° before TDC
Engine speed		800...900 min $^{-1}$
Engine-speed limitation		6570...6630 min $^{-1}$